TRAJECTORIES OF EMOTIONAL INTELLIGENCE IN ADOLESCENT FEMALES WHO ENGAGE IN HIGH RISK SEXUAL BEHAVIORS

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Dedication

This dissertation is dedicated to my darling daughter, Heidi, who made the process of writing and analyzing data exponentially more difficult, but infinitely more worthwhile. To my wonderful husband, Scott, whose patience, caring, and willingness to cook have made it possible to keep going- I don't know how I could have done this without you! To my parents, for their love and support, and especially my mom- for giving up so many weekend days to babysit so I could keep working. To the rest of my friends and family who have provided enormous amounts of support- I love and appreciate you all!

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Chapter I: The Research Problem

Background and Significance

Adolescence is a period characterized by rapid change, where relationships with others and personal growth shape an individual's identity (D'Auria, Christian, Henderson, & Haynes, 2000). Emotions play a large role in the successful navigation through adolescence (Ghee & Johnson, 2008). Brain maturation during this period leads to changes in emotional capacities and ability to regulate emotions (Yurgelun-Todd, 2007). Within a person, emotions serve to connect physiological responses with cognitive thought; emotions create meaning in individual lives and allow for relationships with others. The abilities to recognize and manage emotions are critical to mental health (Schutte, Malouff, Thorsteinsson, Bhullar, & Rooke, 2007). During adolescence, individuals develop the skills necessary to deal with their emotions (Griffith, Dubow, & Ippolito, 1999; Hatzenbuehler, McLaughlin, & Nolen-Hoeksema, 2008). Adolescents engaged in lifestyles characterized by multiple high-risk behaviors may develop these skills differently from other adolescents or not at all.

The concept of emotional intelligence (EI) captures the ability to recognize and manage ones' own and others' emotions. Distinct from general mood, emotional intelligence incorporates intrapersonal, interpersonal, adaptation, and stress management skills (Bar-On, 2006). First introduced in 1990, emotional intelligence has become a hot topic, resulting in a proliferation of studies on EI, including adolescent EI, the relationship of EI to other variables, and interventions utilizing EI (e.g., Charbonneau & Nicol, 2002a, 2002b; Ciarrochi, Deane, Wilson & Rickwood, 2002; Ciarrochi, Wilson, Deane, & Rickwood, 2003; Downey, Mountstephen, Lloyd, Hansen, & Stough, 2008; Goleman, 2001; Lee & Olszewski-Kubilius, 2006; Martinez-Pons, 1998; Parker et al., 2004; Peters, Kranzler, & Rossen, 2009). Emotional intelligence has also been introduced into school curricula, based on the belief that this type of "intelligence" accounts for a great amount of success an individual has in adulthood (for example, the Collaborative for Academic, Social, and Emotional Learning, http://casel.org/). As noted by Parker, Saklofske, Wood, and Collin (2009) EI has received extensive attention in educational literature, however, much of the school curricula and theories of development of emotional intelligence during adolescence appear to be based on conjecture (Matthews, Roberts, & Zeidner, 2004; Parker et al., 2009). Although programs educating students in emotional and social learning resonate with many people, and appear to make sense conceptually, there is much scientific work remaining in the relatively new field of emotional intelligence. Evidence must underlie and lead to practice, including interventions to increase emotional intelligence and education programs to teach emotional intelligence in. Without an evidence base supporting the development emotional intelligence, it is impossible to know if this is something that can be taught or learned, and if so, what difference this type of learning has on outcomes for general and high-risk groups of children and adolescents.

One example of the evidence needed to inform theory– the focus of the current study– is the developmental trajectory of emotional intelligence. This trajectory theoretically includes time during childhood and adolescence in which individuals' emotional intelligence shows remarkable growth (Bar-On, 2006; Goleman, 2001;

Matthews, Roberts, & Zeidner, 2003; Mayer, Salovey, & Caruso, 2008). Emotional intelligence has been linked to both health and risk behaviors during adolescence (Ghee & Johnson, 2008; Hatzenbuehler et al., 2008; Moriarty, Stough, Tidmarsh, Eger, & Dennison, 2001; Rivers, Brackett, Salovey, & Mayer, 2007; Trinidad & Johnson, 2002). Despite numerous educational programs based on this theory, evidence charting the development of emotional intelligence during childhood and adolescence is lacking.

The contexts in which individuals mature have a profound effect on emotional development. Chronic exposure to stressful environments can affect parts of the brain responsible for emotional development, resulting in perhaps, little or no development of emotional intelligence over time. Health risk behaviors often seen in young people from high-risk environments such as addiction-related behaviors, including alcohol and tobacco use, have been linked to lower levels of emotional intelligence (Trinidad & Johnson, 2002).

Other environmental aspects that affect emotional development are the type and quality of social supports available to the individual. Despite chronic exposure to substantial stress, some individuals exhibit resilience and development of positive health and socially responsible behaviors. Protective factors, such as school and family connectedness, have been shown to be related to positive emotional development, even for young people growing up in high-risk environments (McNeely, Nonnemaker, & Blum, 2002; Resnick et al., 1997; Smith & Sandhu, 2004; Svetaz, Ireland, & Blum, 2000).

Significance of the Problem to Adolescent Health

Low emotional intelligence has been linked to numerous health risk behaviors among adolescents, whereas high emotional intelligence has been related to positive health behaviors. Different levels of emotional intelligence appear to influence adolescents' choices and involvement in risk behaviors (Ghee & Johnson, 2008; Hatzenbuehler et al., 2008; Moriarty et al., 2001; Rivers et al., 2007; Trinidad & Johnson, 2002).

Theoretically, adolescence is a critical period in the development of emotional intelligence; however, this theory of development has not been demonstrated with longitudinal research. A better understanding of the developmental trajectory of emotional intelligence among teens engaged in high-risk behaviors could lead to a clearer understanding of the interplay between EI and health risk behaviors, and an awareness of whether variations in the development of emotional intelligence are linked to health outcomes. If evidence confirms that lower levels of emotional intelligence and stress management skills (including failure to change, slow rates of change, and declining levels of stress management skills), lead to risky health behaviors, it may be possible to intervene to increase stress management skills in order to reduce sexual risk behaviors.

Few studies to date have examined associations between adolescents' emotional skills and their sexual behaviors. The current study, a secondary analysis of longitudinal data from the *Prime Time* study, examines the developmental trajectory of EI. *Prime Time* is a clinic-based youth development intervention aimed at reducing multiple risk behaviors among adolescent girls at high-risk for early pregnancy and STI. The *Prime*

Time intervention was recently evaluated in a randomized clinical trial involving 253 13-17 year old adolescent girls who met specified risk criteria. Girls participating in this clinical trial were randomly assigned to intervention (n = 126) and control (n = 127) conditions. All participants completed a *Prime Time* survey at the time of study enrollment and every 6 months for 2½ years. The current study will examine the developmental trajectory of one aspect of emotional intelligence, stress management skills, in adolescents assigned to the control condition of the *Prime Time* study, and will explore how sexual behaviors and social connectedness influence this trajectory.

Statement of Purpose

The main purpose of the current study was to develop a longitudinal model of change in stress management skills in adolescent girls engaged in high-risk sexual behaviors. An additional goal was to explore whether social connectedness (school and family connectedness) and sexual behaviors (number of male sex partners in the 6 months prior to the start of the study and partner communication regarding sexual risk) predict variability in the initial level of stress management skills and in the development of stress management skills over time. This study will aid in understanding why certain adolescent girls have increasing capacity for stress management over time, despite engaging in similar sexual risk behaviors as other girls in the current study. The current study will lend insight into the role that social connectedness, an important aspect of context, plays in the development of stress management skills.

The four specific aims of this study were to: (a) describe stress management skills, social connectedness, and sexual behavior variables and relationships among these variables at the beginning of the study; (b) describe stress management skills over all time points, including exploration of the shape and rate of change in both individuals and groups split into age cohorts, over time; (c) use an accelerated cohort analysis approach to link growth curve segments from each age cohort and create a growth curve trajectory model that best describes the development of stress management skills across cohorts; and (d) conduct a preliminary examination of whether social connectedness and sexual behavior variables measured at the beginning of the study can be used to predict variability in the initial level of stress management skills and change in stress management skills over time.

Findings from this study fill several gaps in the literature. First, this study examined the development of emotional intelligence over a period of several years, including girls who range in age from 14 to 19 years (Sieving, McMorris, et al., 2011). While longitudinal studies of emotional intelligence during adolescence have been called for, a paucity of this type of study exists (e.g., Schutte et al., 2007; Zeidner, Matthews, Roberts, & MacCann, 2003). The current study used a novel method, accelerated cohort design analysis, to connect trajectories of emotional intelligence across age cohorts of girls, in order to study the development of EI from ages 14 to 19.

Second, this study examines the development of emotional intelligence within a population of adolescents at high risk of experiencing health and social disparities. Although it is important to understand development in these high-risk populations in order to provide early and effective interventions, very little research exists on developmental trajectories within such populations. Evidence from the *Prime Time* study confirms that the study's participants are growing up in high-risk environments and many are exposed to high levels of chronic stress (Sieving, McMorris, et al., 2011; Secor-Turner, Garwick, Sieving, & Seppelt, 2011). When individuals mature in high-risk environments, the part of the brain responsible for emotional processing may not fully develop.

Finally, this study examines whether indicators of social connectedness and sexual behaviors help predict initial levels of stress management skills and change in stress management skills over time. Findings from this study will serve as a foundation for understanding how social connectedness and sexual behaviors influence development of emotional intelligence within a vulnerable population of adolescents.

Chapter II: Review of the Literature

Adolescence is a time of great change, where individuals learn to manage their emotions and become productive adult members of society. Teens engaged in high-risk sexual behaviors gamble with negative physical and emotional health outcomes with potentially lifelong consequences. High-risk social contexts play a powerful role in shaping adolescent risk behaviors. The social development model provides a framework for understanding risk and protective factors within adolescents' social contexts that influence the development of high risk behaviors. Attachment theory complements the social development model, providing information on mechanisms through which social relationships influence the ability to regulate emotions. Emotional intelligence theoretically increases over adolescence, however, it is unclear whether adolescents from high-risk social contexts who engage in high-risk behaviors develop emotional intelligence (EI) differently from other adolescents or not at all (Bar-On, 2006; Goleman, 2001; Mayer, Salovey, & Caruso, 2008).

The current study is a secondary analysis of data from a randomized intervention study involving 253 girls ages 13-17 years meeting specified risk criteria. Study participants were recruited from school and community clinics in Minneapolis and Saint Paul, Minnesota. Intervention group participants were involved in *Prime Time* intervention programming plus usual clinic services for 18 months; control group participants received usual clinic services. All participants completed a study survey at the time of enrollment and every 6 months for a 30-month period (only the first 24 months of surveys were used in the current study). Surveys assessed risk behaviors and psychosocial factors targeted for change by *Prime Time* (Sieving, Resnick, et al., 2011). Using longitudinal data from *Prime Time* control group participants, the current study will examine the natural developmental trajectory of one aspect of emotional intelligence, stress management skills, over 24 months time. The study will also investigate whether selected aspects of girls' social contexts and their sexual behaviors at an initial measurement point influence trajectories of stress management skills, allowing a picture of how relationships and connections to both people and places affect the subsequent development of emotional intelligence.

This chapter will begin with a review of the theoretical underpinnings for this study, starting with an overview of adolescent development, followed by an overview of the concept of emotional intelligence and its development during adolescence. This chapter concludes with an examination of theories that provide the framework for the current study: the social development model and attachment theory (Catalano & Hawkins, 1996; Hawkins & Weis, 1985; Hazan & Shaver, 1987). The chapter will then examine the empirical literature on adolescent cognitive and emotional development, both of which impact the development of emotional intelligence. Finally, research examining the roles of social connectedness and health risk behaviors as they relate to the development of EI will be reviewed. Concluding this chapter is a summary of the empirical literature and a description of the current study.

Theoretical Underpinnings

Adolescent development. Adolescence is characterized by rapid change including physical, cognitive, social, and emotional development. Development within the adolescent is paralleled by development in the way adolescents relate with their world. Neurological changes lead to changing ways of handling emotions, while other cognitive changes allow adolescents the ability to take on others' viewpoints and vicariously experience others' emotions (Inhelder & Piaget, 1958; Yurgelun-Todd, 2007). Ultimately, this development creates the capacity to bond with others. Improving ability to read ones' own and others' emotions should lead to a corresponding increase in emotional intelligence (Rosso, Young, Femia, & Yurgelun-Todd, 2004). It is important to note that cognitive and emotional changes do not take place in a prescribed order or at exact points in time. As suggested by the social development model (Catalano & Hawkins, 1996; Hawkins & Weis, 1985), there are multiple influences on an individual's development, which means that some adolescents may experience gains in emotional intelligence at different rates than others. In certain contexts, especially those in which adolescents are unable or do not have the opportunity to form the first important bonds with caregivers or subsequent bonds with school, an adolescent may experience little or no change in emotional intelligence over time. It is even possible that chronically stressful contexts could lead to decreases in emotional intelligence. Cognitive and emotional abilities have been shown to regress as a result of experiencing trauma or extreme stress; therefore, it would be reasonable to assume that individuals would also express lower levels of emotional intelligence as a result of such experiences (Hunt & Evans, 2004).

Emotional intelligence. Emotional intelligence (EI) "comprises abilities related to understanding oneself and others, relating to people, adapting to changing environmental demands, and managing emotions" (Bar-On & Parker, 2000, p. 1). Emotional intelligence is often conceptualized as a "model" and most studies with adolescents use one of two overall models, trait EI or ability EI. There is currently much debate in the literature surrounding the "correct" way to conceptualize emotional intelligence. However, the ways these two models conceptualize EI tend to be complimentary rather than contradictory, with a high degree of similarity in EI. In an extensive review of the adolescent literature the clearest distinction between models was in operationalization, or measurement, of emotional intelligence, with trait-based models utilizing self-report inventories and ability-based models using performance measures (Lando-King, 2009). Petrides, Frederickson, and Furnham (2004) distinguish between these models as follows:

> *Trait EI* (or 'emotional self-efficacy') refers to a constellation of *behavioral dispositions* and *self-perceptions* concerning one's ability to recognize, process, and utilize emotion-laden information. It encompasses various dispositions from the personality domain, such as empathy, impulsivity, and assertiveness as well as elements of social intelligence (Thorndike, 1920) and personal intelligence (Gardner, 1983), the latter two in the form of self-perceived abilities. *Ability* EI

> (or 'cognitive-emotional ability') refers to one's *actual* ability to recognize, process, and utilize emotion-laden information. (pp. 278)

Despite the clarity of the distinction provided by Petrides et al. (2004), the definitions utilized by researchers who study emotional intelligence are remarkably similar. In fact, definitions of emotional intelligence, by themselves, are often not enough to determine whether the researchers are utilizing a trait model or ability model.

In the literature on emotional intelligence, the two models of EI are often broken down into separate dimensions. Parker, Taylor, Eastabrook, Schell, and Wood (2008) found that the following dimensions were usually present in trait and ability emotional intelligence models: the ability to detect emotions in oneself and others, the ability to express emotions the ability to regulate emotions, and the ability to use emotions to guide behaviors. Tables 2.1 – 2.2 come from studies of emotional intelligence in adolescent populations. The dimensions of EI presented in Table 2.1 essentially replicate Parker et al.'s findings. As can be seen in Table 2.1, the number and definitions of dimensions varied across studies and was not related to whether a trait or ability model of emotional intelligence was used. For example, while the conceptualization and dimensions of emotional intelligence described by Downey, Mountstephen, Lloyd, Hansen and Stough (2008) were very similar to that of Luebbers, Downey, and Stough (2007), although the former was identified as a trait model and the latter as an ability model of EI.

As previously mentioned, the main distinction between the two different emotional intelligence models is in the operationalization, or measurement, of EI. Trait-based measures utilize self-report, while ability-based measures (also called maximum-performance tests) use tests with correct and incorrect answers. Table 2.2 presents more information on selected studies of adolescent EI listed in Table 2.1, including the setting of the study,the age range of adolescents in the study, internal consistency reliability for the EI measure used, and correlations between EI and health or educational outcomes examined by the study. Interestingly, the majority of studies in these tables utilized self-report (trait-based) measures of emotional intelligence (the categorization of the measure is based on reports from the creator). In fact, only one study used an ability-based measure of EI (MSCEIT-YV; Peters, Kranzler, & Rossen, 2009). This was in marked contrast to the number of studies that reported using an ability model in their conceptualization of emotional intelligence (Luebbers et al., 2007; Martinez-Pons, 1998; Moriarty, Stough, Tidmarsh, Eger, & Dennison, 2001).

The Bar-On model of EI, a trait-based model, was used in the studies by Harrod and Scheer (2005), Hindes, Thorne, Schwean, and McKeough (2008), Lee and Olszewski-Kubilius (2006), Parker et al. (2004), and Parker et al. (2008). Similar to other models of emotional intelligence, the Bar-On model encompasses four distinct dimensions of emotional intelligence. The first dimension is **intrapersonal skills**, which includes the ability to recognize, express, and regulate one's own emotions (Parker et al., 2004). According to Bar-On and Parker, individuals who score highly on intrapersonal skills understand their own emotions and are able to communicate these emotions effectively. The **interpersonal skills** dimension is similar to the intrapersonal dimension, except that it requires the ability to recognize and affect emotions in others; additionally, one is able to empathize with the way someone else is feeling. Individuals who score highly in interpersonal skills have good interpersonal relationships and demonstrate understanding and skills of a good listener (Bar-On & Parker). The dimension of **adaptability** is characterized by the flexibility and problem solving skills required to adjust one's mood to the current situation (Lee & Olszewski-Kubilius, 2006; Parker et al., 2004). Individuals who score highly on the adaptability scale deal well with everyday issues, finding positive ways to solve problems that arise (Bar-On & Parker). The final dimension, **stress management skills**, includes the ability to cope positively with stress and to control one's emotions regardless of the situation. "These individuals [with high stress management skills] are generally calm and work well under pressure. They are rarely impulsive and can usually respond to a stressful event without an emotional outburst" (Bar-On & Parker, p.19).

Table 2.1

Emotional Intelligence Trait and Ability Models: Dimension Names and Descriptions

Authors	EI Model (# of Dimensions)	Dimension Name & Description			
Charbonneau & Nicol (2002b)	Trait (2)	**Name:** Intrapersonal **Description:** "Being able to help oneself by using one's emotions. To do this, one must be aware of personal emotions and moods, be able to manage them and to use them to motivate oneself." (p. 1102)		**Name:** Interpersonal **Description:** "Focuses on helping others. To help others, one must identify and respond to others' moods and emotions, guide these emotions toward a positive outcome, and help others help themselves" (p. 1102)	
Ciarrochi et al. (2001)	Trait (4)	**Name:** Emotion Perception **Description:** "The ability to discern one's own and other's emotions" (p. 1107)	**Name:** Managing Self-Relevant Emotions **Description:** "The capacity for adaptively coping with aversive or distressing emotions by using self-regulatory strategies that ameliorate the intensity or duration of such emotional states" (p. 1108)	**Name:** Managing Others' Emotions **Description:** "The ability to arrange events others enjoy, hide negative emotions in order to avoid hurting another person's feelings, and make others feel better when they are down" (p. 1108)	**Name:** Emotion Utilization **Description:** Not used as separate dimension in study

Table 2.1 Continued

Authors	EI Model (# of Dimensions)	Dimension Name & Description			
Downey et al. (2008)	Trait (4)	**Name:** Emotional Recognition & Expression **Description:** "The ability to identify one's own feelings and emotional states and the ability to express those inner feelings to others" (p. 12)	**Name:** Understanding Emotions **Description:** "The ability to identify and understand the emotions of others" (p. 13)	**Name:** Emotions Direct Cognition **Description:** "The extent to which emotions and emotional knowledge are incorporated in decision-making and/or problem solving" (p. 13)	**Name:** Emotional Management & Control **Description:** "The ability to management positive and negative emotions both within oneself and others and control strong emotional states" (p. 13)
Hindes et al. (2008)	Trait (4)	**Name:** Intrapersonal **Description:** "Evaluates the inner self (self-regard, self-expression, assertiveness, independence, and self-actualization)" (p.220)	**Name:** Interpersonal **Description:** "Measures social awareness and interpersonal skills and functioning, such as empathy, social responsibility, and interpersonal relationships" (p.220)	**Name:** Adaptability **Description:** "Examines how successfully one can cope with environmental demands by understanding and solving problematic situations" (p.220)	**Name:** Stress Management **Description:** "Measures ability to withstand stress without losing control (emotional management and regulation, stress tolerance, and impulse control)" (p.220)

Table 2.1 Continued

Authors	EI Model (# of Dimensions)	Dimension Name & Description				
Lee & Olszewski-Kubilius (2006)	Trait (4)	**Name:** Intrapersonal Abilities **Description: "**Self-awareness, assertiveness, independence, self-actualization" (p. 43)	**Name:** Interpersonal Abilities **Description:** "Empathy, social responsibility, interpersonal relationship" (p. 43)	**Name:** Adaptability **Description:** "Flexibility, problem solving" (p. 43)	**Name:** Stress Management **Description:** "Stress tolerance, impulse control" (p. 43)	
Luebbers et al. (2007)	Ability (5)	**Name:** Emotional Recognition and Expression (in oneself) **Description:** "The ability to identify one's own feelings and emotional states, and the ability to express those inner feelings to others" (p. 1000)	**Name:** Emotions Direct Cognition **Description:** "The extent to which emotions and emotional knowledge are incorporated in decision making and/or problem solving" (p. 1000)	**Name:** Understanding of Emotions External **Description:** "The ability to identify and understand the emotions of others" (p. 1000)	**Name:** Emotional Management **Description:** "The ability to mange positive and negative emotions within both oneself and others" (p. 1000)	**Name:** Emotional Control **Description:** "How effectively emotional states experienced, such as anger, stress, anxiety, and frustration are controlled" (p. 1000)
Martinez-Pons (1998)	Ability (3)	**Name:** Attention **Description:** "Attention to one's moods and emotions" (p. 4-5)	**Name:** Clarity **Description:** "One's ability to discriminate among [emotions]" (p. 4-5)	**Name:** Repair **Description:** "One's ability to regulate [emotions]" (p. 4-5)		

Table 2.1 Continued

Authors	EI Model (# of Dimensions)	Dimension Name & Description			
Moriarty et al. (2001)	Ability (4)	**Name:** Branch 1 of Mayer & Salovey's model of EI[a] **Description:** "recognition of emotions in others" (p. 745)	**Name:** Branch 2 of Mayer & Salovey's model of EI (not used in study) **Description:** Not described	**Name:** Branch 3 of Mayer & Salovey's model of EI[a] **Description:** "Interpreting the meaning that emotions convey regarding interpersonal relationships" (p. 745)	**Name:** Branch 4 of Mayer & Salovey's model of EI[a] **Description:** "clarity of moods and ability to repair moods" (p. 745)
Parker et al. (2004)	Trait (4)	**Name:** Intrapersonal Abilities **Description:** "Consisting of related abilities like recognizing and labeling one's feelings" (p.1323)	**Name:** Interpersonal Abilities **Description:** "Consisting of related abilities like identifying emotions in others or empathy" (p.1323)	**Name:** Adaptability **Description:** "Consisting of abilities like being able to adjust one's emotions and behaviors to changing situations or conditions" (p.1323)	**Name:** Stress Management **Description:** "Consisting of abilities like delaying or resisting an impulse" (p.1323)
Parker et al. (2008)	Trait (4)	Same as above			

Table 2.1 Continued

Authors	EI Model (# of Dimensions)	Dimension Name & Description			
Peters et al. (2009)	Ability (4)	**Name:** Perceiving Emotions	**Name:** Facilitating Emotions	**Name:** Understanding Emotions	**Name:** Managing Emotions
		Description: Perceive emotions	**Description:** Use emotions to facilitate thought	**Description:** Understand emotions	**Description:** Manage emotions
Trinidad & Johnson (2002)	Ability (4)	**Name:** Emotional Identification (4)	**Name:** Understanding Emotions	**Name:** Managing Emotions	**Name:** Assimilating Emotions (not assessed)
		Description: Not described	**Description:** Not described	**Description:** "how well students were able to manageme their own and others' emotions"	**Description:** "assessing one's ability to generate emotions" (p. 98)

[a]Moriarty et al. (2001) did not provide names for the dimensions further than stating that branches 1, 3, and 4 of "Mayer and Salovey's mental model [an ability model] of emotional intelligence" (p. 745) were used.

Table 2.2

Emotional Intelligence Measures: Reliability and Study Outcomes

Author (Year)	Setting	Age	*N*	Scale(s)	Internal Consistency Reliability	Outcome (Correlation/Relationship with EI measure)
Charbonneau & Nicol (2002b)	Camp	12-17	191	• SREIT[a] (used to measure intrapersonal EI)	• α = .90	• Self-rated interpersonal EI (*r* = .49**) • Peer-rated interpersonal EI (*r* = .14) • Empathy (*r* = .22**) • Socially desirable behaviors (*r* = .49**) • Peer-rated popularity (*r* = -.01) • Task leadership (*r* = .05) • Socio-emotional leadership (*r* = .04)
				• Wiesinger's EI Scale[b] (used to measure self-reported interpersonal EI)	• α = .86	• Peer-rated interpersonal EI (*r* = .09) • Empathy (*r* = .30**) • Socially desirable behaviors (*r* = .34**) • Peer-rated popularity (*r* = .21) • Task leadership (*r* = .34**) • Socio-emotional leadership (*r* = .38**)
				• Weisinger's EI Scale[b] (used to measure peer-reported interpersonal EI)	• Not reported	• Empathy (*r* = .10) • Socially desirable behaviors (*r* = .15) • Peer-rated popularity (*r* = .10) • Task leadership (*r* = .35**) • Socio-emotional leadership (*r* = .36**)
Ciarrochi et al. (2001)	School	13-15	131		**SREIT[a]**	
				• Total Scale	• α = .84	• Self esteem (*r* = .41**) • Trait anxiety (*r* = -.43**)
				• Emotion perception	• α = .76	• Self esteem (*r* = .22*) • Trait anxiety (*r* = -.21*)
				• Managing self-relevant emotions	• α = .63	• Self esteem (*r* = .51**) • Trait anxiety (*r* = -.49**)

Table 2.2 Continued

Author (Year)	**Setting**	**Age**	***N***	**Scale(s)**	**Internal Consistency Reliability**	**Outcome (Correlation/Relationship with EI measure)**
Ciarrochi et al. (2001) Continued				• Managing other's emotions	• α = .66	• Self esteem (*r* = .28**) • Trait anxiety (*r* = -.33**)
				• Emotion utilization	• α = .55	• Self esteem (*r* = .15) • Trait anxiety (*r* = -.14)
Lee & Olszewski-Kubilius (2006)	Camp	*M* = 16.2	230		**Bar-On EQ-i:**	**YV(S)[c]**
				• Total EI	• α = .84	• SAT score (*r* = -.02) • Post-conventional schema[d] (*r* = .06) • Maintaining norms schema[d] (*r* = -.06) • Personal interest schema[d] (*r* = -.05) • Self-reported leadership behavior (*r* = .00)
				• Intrapersonal Ability	• Not reported separately	• SAT score (*r* = .05) • Post-conventional schema[d] (*r* = .10) • Maintaining norms[d] (*r* = .00) • Personal interest schema[d] (*r* =.00) • Self-reported leadership behavior (*r* = .05)
				• Interpersonal ability	• Not reported separately	• SAT score (*r* = -.02) • Post-conventional schema[d] (*r* = -.05) • Maintaining norms[d] (*r* = .03) • Personal interest schema[d] (*r* = .01) • Self-reported leadership behavior (*r* = .01)
				• Adaptability	• Not reported separately	• SAT score (*r* = .08) • Post-conventional schema[d] (*r* = .04) • Maintaining norms[d] (*r* = .03) • Personal interest schema[d] (*r* = -.05) • Self-reported leadership behavior (*r* = -.13)

Table 2.2 Continued

Author (Year)	Setting	Age	*N*	Scale(s)	Internal Consistency Reliability	Outcome (Correlation/Relationship with EI measure)
Lee & Olszewski-Kubilius (2006) Continued				• Stress Management	• Not reported separately	• SAT score (*r* = -.13) • Post-conventional schema[d] (*r* = .06) • Maintaining norms[d] (*r* = -.15*) • Personal interest schema[d] (*r* = -.06) • Self-reported leadership behavior (*r* = .06)
Luebbers et al. (2007)	School	11-18	1002	**Adolescent SUEIT[e]**		
				• Total EI	• α = .85	This article described the empirical development of an adolescent version of the SUEIT, no other outcomes were examined
				• Understanding and analyzing emotions	• α = .81	
				• Perception and expression of emotions	• α = .75	
				• Emotional management and control	• α = .75	
				• Emotions direct cognition	• α = .75	
Moriarty et al. (2001)	Sex offenders: group or individual counseling sessions Non-sex offenders: schools	14-17	69	**TMMS[f]**		Comparison of sex offenders and non-sex offenders' responses conducted using a discriminant analysis (*F*-Ratio)
				• Total EI	• α = .84	• $F(1, 62) = 0.11$
				• Attention to feelings	• Not given	• $F(1, 62) = 6.07$*
				• Clarity of feelings	• Not given	• $F(1, 62) = 1.85$
				• Mood repair	• Not given	• $F(1, 62) = 0.66$

Table 2.2 Continued

Author (Year)	Setting	Age	*N*	Scale(s)	Internal Consistency Reliability	Outcome (Correlation/Relationship with EI measure)
Parker et al. (2004)	School	14-16	667	**Bar-On EQ-i:YV[c]**		
				• Total EI	• Not given	• GPA (*r* = .33*)
				• Interpersonal	• Not given	• GPA (*r* = .32*)
				• Intrapersonal	• Not given	• GPA (*r* = .08*)
				• Adaptability	• Not given	• GPA (*r* = .27*)
				• Stress management	• Not given	• GPA (*r* = .24*)
Parker et al. (2008)	Community	13-18	667	**Bar-On EQ-i:YV[c]**		
				• Total EI	• α = .91	• Younger adolescents (13-15) • Problem video gaming (*r* = -.32*) • Internet addiction (*r* = -.38*) • Problem gambling (*r* = -.21*) • Older adolescents (16-18) • Problem video gaming (*r* = -.27*) • Internet addiction (*r* = -.30*) • Problem gambling (*r* = -.22*)
				• Intrapersonal	• α = .85	• Younger adolescents (13-15) • Problem video gaming (*r* = -.22*) • Internet addiction (*r* = -.06) • Problem gambling (*r* = -.07) • Older adolescents (16-18) • Problem video gaming (*r* = -.20*) • Internet addiction (*r* = -.11*) • Problem gambling (*r* = -.04)

Table 2.2 Continued

Author (Year)	Setting	Age	*N*	Scale(s)	Internal Consistency Reliability	Outcome (Correlation/Relationship with EI measure)
Parker et al. (2008) Continued				• Interpersonal	• α = .82	• Younger adolescents (13-15) • Problem video gaming (*r* = -.32*) • Internet addiction (*r* = -.24*) • Problem gambling (*r* = -.26*) • Older adolescents (16-18) • Problem video gaming (*r* = -.36*) • Internet addiction (*r* = -.29*) • Problem gambling (*r* = -.32*)
				• Adaptability	• α = .88	• Younger adolescents (13-15) • Problem video gaming (*r* = -.09) • Internet addiction (*r* = -.38*) • Problem gambling (*r* = -.06) • Older adolescents (16-18) • Problem video gaming (*r* = -.09*) • Internet addiction (*r* = -.21*) • Problem gambling (*r* = -.18*)
				• Stress management	• α = .87	• Younger adolescents (13-15) • Problem video gaming (*r* = -.27*) • Internet addiction (*r* = -.40*) • Problem gambling (*r* = -.22*) • Older adolescents (16-18) • Problem video gaming (*r* = -.15*) • Internet addiction (*r* = -.27*) • Problem gambling (*r* = -.16*)

Table 2.2 Continued

Author (Year)	Setting	Age	*N*	Scale(s)	Internal Consistency Reliability	Outcome (Correlation/Relationship with EI measure)
Peters et al. (2009)	School	10-18	50		**MSCEIT-YV**[g]	
				• Total EI	• α =.84	• General intellectual ability (*r* = .35*) • Reading ability (*r* = .35*) • Math ability (*r* = .17) • Task-oriented coping (*r* = .14) • Emotion-oriented coping (*r* = -.46*) • Avoidance coping (*r* = .11) • Discipline Referrals (*r* = -.47*)
				• Perceiving emotions	• Not given	• General intellectual ability (*r* = .40*) • Reading ability (*r* = .44*) • Math ability (*r* = .22) • Task-oriented coping (*r* = .08) • Emotion-oriented coping (*r* = -.50*) • Avoidance coping (*r* = -.18) • Discipline Referrals (*r* = -.60*)
				• Facilitating emotions	• Not given	• General intellectual ability (*r* = .12) • Reading ability (*r* = .31*) • Math ability (*r* = .15) • Task-oriented coping (*r* = .30) • Emotion-oriented coping (*r* = -.15) • Avoidance coping (*r* = .19) • Discipline Referrals (*r* = -.47*)

Table 2.2 Continued

Author (Year)	Setting	Age	*N*	Scale(s)	Internal Consistency Reliability	Outcome (Correlation/Relationship with EI measure)
Peters et al. (2009) Continued				• Understanding emotions	• Not given	• General intellectual ability (r = .41*) • Reading ability (r = .40*) • Math ability (r = .25) • Task-oriented coping (r = .02) • Emotion-oriented coping (r = -.48*) • Avoidance coping (r = -.09) • Discipline Referrals (r = -.33*)
				• Managing emotions	• Not given	• General intellectual ability (r = .22) • Reading ability (r = .07) • Math ability (r = -.03) • Task-oriented coping (r = .06) • Emotion-oriented coping (r = -.33) • Avoidance coping (r = -.11) • Discipline Referrals (r = -.18)
Trinidad & Johnson (2002)	School	11-18	205		**MEIS**[h]	
				• Total EI	• Not given	• Tobacco use (r = -.19*) • Alcohol use (r = -.16*)
				• Emotional identification	• Not given	• Tobacco use (r = -.18*) • Alcohol use (r = -.18*)
				• Understanding emotions	• Not given	• Tobacco use (r = -.15*) • Alcohol use (r = -.17*)
				• Managing emotions	• Not given	• Tobacco use (r = -.02) • Alcohol use (r = .02)

[a]SREIT = Schutte Self-Report Emotional Intelligence Test; [b]Weisinger's (1998) emotional intelligence scale; [c]Bar-On EQ-i:YV = Bar-On Emotional Quotient Inventory (Youth Version), (s) indicates short version; [d]Lee & Olszewski-Kubilius (2006) used the Defining Issues Test-2 (DIT-2) to measure how students defined and judge social justice, this measure is based on a theory of moral judgement development (Kohlberg); individuals with a post-conventional schema

“‘focus on organizing a society by appealing to consensus-producing procedures’” (p. 46); people who support the maintaining norms schema want to maintain current social laws and norms; the personal interest schema is found in people who consider their personal interest in making moral decisions; [e]Adolescent SUEIT = Adolescent Swinburne University Emotional Intelligence Test, developed and normed for Australian participants; [f]TMMS = Trait Meta-Mood Scale; [g]MSCEIT-YV = Malovey-Salovey-Caruso Emotional Intelligence Test: Youth Version; [h]MEIS = Multifactor Emotional Intelligence Scale, Student Version

*p < .05 **p < .01

Development of emotional intelligence during adolescence. According to Mayer, Salovey, and Caruso (2008), EI develops with age. Bar-On (2006) also asserted that EI increases with age in children and adolescents, suggesting that development of EI is similar to known development of cognitive intelligence from early adolescence through late adolescence. Goleman (2001) argued that emotional intelligence meets the criteria of a traditional intelligence because it has a precise developmental history within an individual. This developmental trajectory can be observed in children and adolescents. Based on neurobiological evidence, Yurgelun-Todd (2007) asserted that adolescence is a period of time characterized by "an increased ability to read social and emotional cues and an increased appreciation and dependence on interpersonal relationships" (p. 251). This combined increase in ability and greater interest and need for relationships with others should serve to advance emotional intelligence. In sum, as adolescents age there should be corresponding increases in emotional intelligence scores.

The current study is based on adolescent developmental theory and the notion that emotional intelligence changes over time. Research on the development of emotional intelligence during adolescence is scarce. The current study will contribute to an area that has been largely unexplored by longitudinal research. Using five waves of data collected over a 24-month period during adolescence in four cohorts from age 13 to age 19, this study will contribute to understanding the development of emotional intelligence across the adolescent years from 13 – 19 , as well as developmental variations that occur within a vulnerable population of adolescents. Within this population, normative levels of emotional intelligence during early adolescence and the ways that EI changes over the course of adolescence are unknown. Initial levels of emotional intelligence may be lower than average in this high-risk adolescent population, or there may be no differences between these youth and more heterogeneous samples of youth. Within this population, it is possible that individuals will experience slower and faster rates of growth in emotional intelligence. Some individuals may experience no growth at all, while others may have EI scores that decrease over time.

Development in context. Adolescents do not develop health promoting or high-risk behaviors in a vacuum; personal characteristics and the environments within which an individual is embedded interact over time culminating in skills and behavioral expression. In efforts to understand and predict developmental trajectories of emotional intelligence for individuals as well as groups of adolescents, it is important to understand the contexts in which these skills are honed. Social contexts as well as early attachments contribute to the development of emotional skills, positive and negative health behaviors. The social development model (SDM) and attachment theory aid in understanding contextual and early attachment effects on the development of stress management skills and other aspects of emotional intelligence.

Social development model. The social development model informed the conceptual framework for this study because it described how the existence of strong **pro-social bonds** with family and school could lead to the development of **pro-social skills**, including emotional intelligence and stress management skills, and, ultimately, to reduction in **risk behaviors** during adolescence. The opportunity for youth to build bonds with prosocial individuals and institutions, through meaningful involvement, positive skill development, and positive feedback lead to the development of emotional intelligence skills. These prosocial bonds, combined with emotional intelligence skills, ultimately result in prosocial and healthy behaviors (Lonczak et al., 2001; United Nations, 2003).

Although the current study does not examine prerequisites for forming positive bonds with family or school, it does assess whether adolescent girls in the study feel strongly bonded or connected to both, as represented by measures of family and school connectedness. According to the SDM, teens who perceive a high degree of connection to their family and school have experienced positive interactions within these settings, and are less likely to engage in negative or destructive behaviors. Teens who perceive these positive social connections already show a degree of emotional intelligence. With guidance from their families and schools, it is hypothesized that these teens will continue to develop positive stress management skills during their adolescent years.

Although the *Prime Time* survey instrument does not include questions about experiences in childhood, clues to participants' childhood development are found in their reports of family and school connectedness, engagement in risky and protective sexual behaviors, and development of emotional intelligence skills. Examining variables central to the social development model provides insight to both the context and experiences that girls had while growing up. Specifically, low levels of bonding or connectedness to family and/or school serve as clues that individuals may not have had opportunities for prosocial involvement that are important for development.

Attachment theory. The social development model highlights the importance of adolescents' contexts and bonds with people in these contexts as predictors of positive or negative behavior. This model does not make explicit the indispensable nature of these bonds to the development of emotional intelligence. By using attachment theory to complement the social development model, further insight is gained into how and why bonds are important (Hazan & Shaver, 1987). Attachment theory details how early experiences within the family context help to determine one's ability to form social relationships and ability to regulate emotions (including their emotional intelligence and stress management skills; Ainsworth, 1973). Hazan and Shaver extended a theory of infant attachment styles from Ainsworth to describe attachment styles of adolescent and adult romantic relationships. Based on Ainsworth's theory, people develop styles of attachment as infants, in part through their interactions with primary caregivers, usually their mothers. Hazan and Shaver proposed that adolescents and adults can develop one of three styles of attachment: **secure attachment,** where the person is skilled in social interactions and able to develop secure and satisfying relationships; **avoidant attachment,** where the person is uncomfortable in close relationships; and **anxious or anxious-ambivalent attachment**, characterizing persons who "lack self-confidence; are worried about rejection and abandonment; are prone to bouts of jealousy and anger at relationship partners who are perceived as untrustworthy; are eager to become involved in romantic relationships despite their perils; and are likely to engage in inappropriately intimate self-disclosures, to fall in love quickly and perhaps indiscriminately, and to experience frequent breakups and reunions" (Cooper, Shaver, & Collins, 1998, p. 1381).

Teens who exhibit an anxious or anxious-ambivalent style of attachment to romantic partners and other significant people in their lives are likely to have low emotional intelligence, lack the ability to identify or manage their own emotions, and have difficulty dealing with others' emotions. These teens are likely to get involved in multiple relationships, have multiple partners and use short-term relationships to satisfy a need to feel loved. Empirical studies have confirmed the theoretical connections between attachment style, emotional adjustment and sexual risk behaviors. For example, Cooper et al. found that insecure attachment (including avoidant and anxious-ambivalent attachment styles) was associated with indicators of low emotional intelligence including anger, self-consciousness, low self esteem and low self-confidence. Cooper et al. also found that adolescents with an anxious-ambivalent attachment style were significantly more likely to be sexually experienced and to have had sex with strangers than adolescents with other attachment styles.

The current study proposes that a combination of these two theoretical models can be used to explain contexts that lead to the development of emotional intelligence, and stress management skills, during adolescence. The social development model describes the pro-social bonds that are important to the development of emotional intelligence, including bonds to family and school, and the mechanisms (i.e., opportunities for meaningful involvement, positive skill development, and positive feedback) through which these bonds are created. Attachment theory adds to this by describing how early experiences contribute to the ability to form these bonds and ultimately develop emotional intelligence. Attachment theory also aids in understanding how adolescents' current behaviors in romantic relationships reflect the type of bonds an individual is able to create with others. Both positive (early communication with a partner regarding sexual risk) and risky (multiple male sex partners in the six months prior to the initial survey) sexual behaviors examined by the current study can be thought of as indicators of adolescents' attachment style. These behaviors may also provide evidence about emotional intelligence in these participants, with girls who have sex with multiple partners more likely to exhibit anxious-ambivalent attachment which is likely related to lower emotional intelligence. The overall conceptual model guiding this study is depicted in Figure 2.1, where indicators of prosocial connectedness and sexual behaviors are used to predict the developmental trajectory of stress management skills during adolescence, from the ages 13 to 19.

Empirical Evidence

Cognitive and emotional development. Brain development occurs over the entire lifespan, with significant changes occurring during adolescence. The dramatic changes that occur in the brain during adolescence contribute emotional development (Spear, 2007). Throughout the adolescent years, an individual's brain moves from being the brain of a child with numerous synaptic channels and relatively slower functioning to the brain of an adult, with fewer synaptic connections and rapid communication among the different regions of the brain (Spear). The rapid rate of brain development helps explain some of the challenges individuals face as they traverse the important period of adolescence.

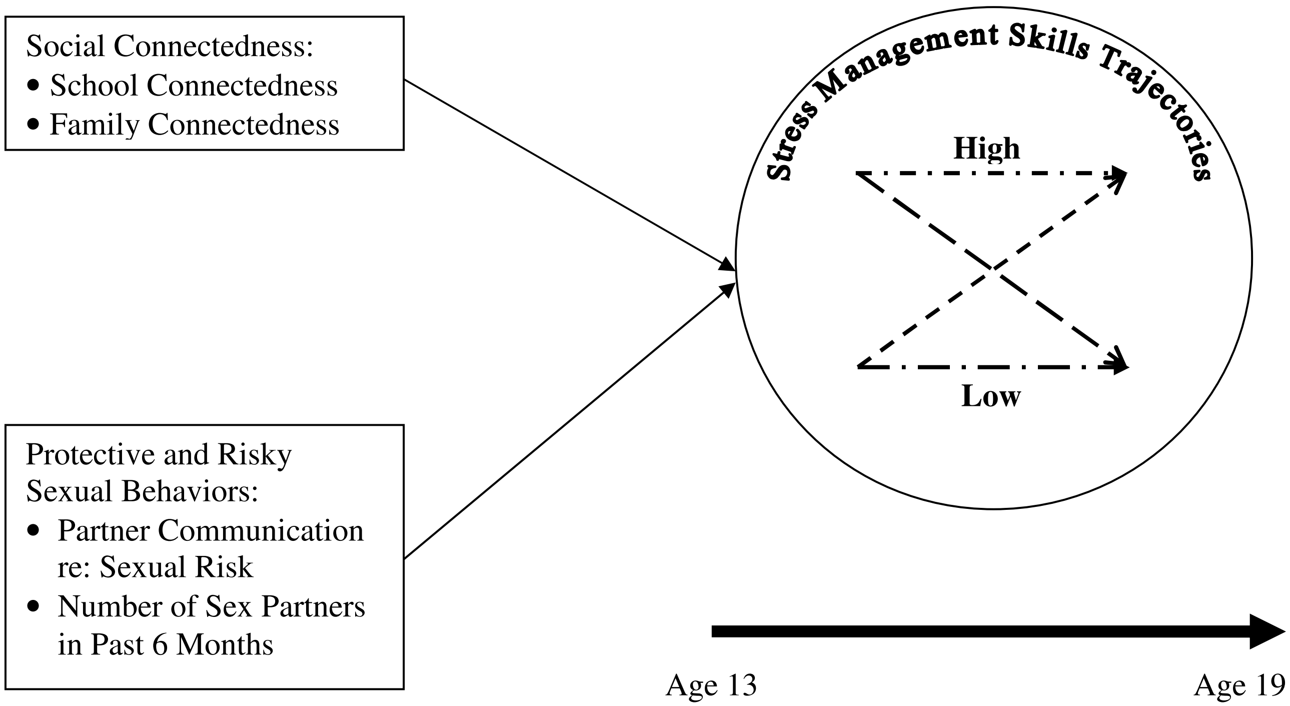

Figure 2.1. Two-part conceptual model for the development of stress management skills during adolescence. Each dotted/dashed line indicates a potential trajectory of stress management skills development.

During this period of transition, adolescents are learning to deal with the faster functioning of their brains in addition to adjusting to the hormonal changes and physical development they are experiencing.

The limbic system of the brain is often referred to as the brain's "emotion center" and is used to automatically process different emotional and behavioral stimuli, including recognition of emotional expressions and storage of emotional memories. By the time babies reach toddlerhood, if they have grown up in appropriately stimulating and nurturing environments, they will have fully functioning, although relatively immature, limbic systems (Masten, 2007). The ability to further process emotional stimuli from the limbic system and moderate emotional responses begins with development of the frontal cortex of the brain. During adolescence the frontal cortex undergoes major development that continues into early adulthood. The frontal cortex is one of the last regions of the brain to achieve functional maturity (Dempster & Corkill, 1999). The development of the frontal cortex and the limbic system allows teens to control emotional reactions and impulses, both of which are key to emotional intelligence and, specifically, to stress management skills.

The frontal cortex is the part of the brain most likely to be influenced by the environmental contexts to which an adolescent is exposed, because of its development relatively later in life (Greenberg, Riggs, & Blair, 2007). This means that the ability to analyze and control emotional reactions and impulses does not develop until adolescence and can be negatively impacted by high-risk social contexts during adolescence. Adolescents who have deficits in higher level abilities (requiring areas such as the frontal cortex to be more mature) are more likely to engage in destructive and risky behaviors (Moffitt, 1993; White et al., 1994). These findings support the link between brain development and risky behaviors. In addition, behaviors observed in someone with an underdeveloped frontal cortex, such as impulsivity, can be described as lacking emotional intelligence and stress management skills.

Development of emotional intelligence and stress management skills. Maturation of the frontal cortex during adolescence lends support to the notion that emotional intelligence increases throughout this developmental period. Someone with an underdeveloped frontal cortex would most likely have difficulty controlling their impulses, a key aspect of stress management skills. As this individual's frontal cortex continues to develop, they may become better at controlling their impulses as well as demonstrating other indicators of increasing emotional intelligence. However, if this individual has been raised in an environment that does not foster positive growth and development, it is possible that their frontal cortex will remain underdeveloped and that their emotional intelligence levels may not increase over time. For example, Greenberg et al. (2007) found that adolescents with an underdeveloped frontal cortex were likely to act very impulsively when in highly emotional states, which could be considered a sign of low emotional intelligence.

Based on the evidence described previously, the development of emotional intelligence is most likely influenced by reciprocal, dynamic relationships between an individual's social, emotional, and cognitive development and the environment. Social, emotional and cognitive development are influenced by exposure to stressful and dysfunctional relationships within ones' environment. In turn, emotional intelligence helps to determine how an individual will react to stressors within their environment (Ciarrochi, Deane, Wilson, & Rickwood, 2002; Pau & Croucher, 2003; Slaski & Cartwright, 2002, 2003). Slaski and Cartwright (2003) describe how emotional intelligence is related to emotions and the environment: "…emotional intelligence is considered to account for individual differences in the capacity to process information of an emotional nature and to be able to relate these to wider cognitions" (p. 234).

Effects of stress on development. There are many normative developmental stressors in the everyday lives of teenagers, even those teens who live grow up in "low-risk" environments with numerous protective factors. Physically, teens are learning to deal with stresses related to their physical growth, the faster synaptic connections occurring in their brains, and changing hormonal influences on thoughts and emotions. Socially, teens are experiencing stresses related to new social roles and social expectations. This is a time when peers are especially important and individuals use these relationships to experiment with new identities. These relationships are important, but can be tumultuous as teens experience new levels of closeness with peers and learn to define their own set of beliefs. Teens often strive for independence from their families, which may, at times, put them at odds with their parents. Aspects of school, such as changing school or transitioning from school to work and career, can introduce additional stressors. Although families and school can be sources of stress, these contexts can also provide substantial support and protection against other life stressors.

In addition to the normative developmental stressors faced by the majority of adolescents, many of the girls in the current study live in social contexts known to contribute to chronically high levels of stress. High-risk behavior does not develop in a vacuum; adolescents engaged in high risk behaviors have often been exposed to high levels of stress during crucial periods of development. Poverty is a common stressor within the social environments of many of the adolescents in the *Prime Time* study. Many (51.2%) of the girls in the current study reported that their families received public assistance, a commonly accepted indicator of low socio-economic status (SES). Low SES has been linked with a range of negative outcomes during childhood and adolescence including maladaptive socio-emotional development, psychiatric disturbance, poor social functioning and delinquent behavior (Bradley & Corwyn, 2002). The link between low SES and negative outcomes is due, in part, to the high levels of stress to which young people growing up in poverty are exposed (Evans, Brooks-Gunn, & Klebanov, 2011). Chaos often characterizes neighborhood, school and home environments of children living in deep poverty. According to Evans et al., these conditions lead to "toxic stress" which can damage areas of the brain used for cognition. Disadvantaged children have been shown to have high levels of chronic physiological stress as evidenced by elevated resting blood pressure and higher levels of chronic stress hormones (Evans et al.). High stress environments can stunt emotional and cognitive development that, theoretically, cause increasing risk for problems in the development of emotional intelligence (including stress management skills) during adolescence (Greenberg et al., 2007).

Research is lacking on how emotional intelligence develops in young people growing up in high-stress environments. Previous research suggests that high levels of emotional intelligence moderate the effect of stress on individuals. However, exposure to chronic stress may make it difficult for the brain development needed for the maturation of emotional intelligence to occur (Mikolajczak, Roy, Luminet, Fillée, & de Timary, 2007). Based on evidence regarding other aspects of cognitive and emotional development in children and adolescents who are exposed to chronic stress, it is probable that the normative development of emotional intelligence would be challenged in a population of adolescent girls from high-risk environments who are engaged in high-risk behaviors.

School and family connectedness and emotional intelligence. As noted previously, exposure to chronic stress during childhood and adolescence can result in numerous morbidities including poor physical and emotional health, and may be expressed through engagement in high-risk behaviors. On the other hand, young people who grew up facing these challenges can also exhibit amazing resilience, triumphing despite what seem to be insurmountable obstacles. A number of protective factors have been linked with resilience. According to Resnick et al. (1997): "Of the constellation of forces that influence adolescent health risk behavior, the most fundamental are the social contexts in which …adolescents are embedded; [and] the family and school contexts are among the most critical…" (p. 823). Protective social contexts examined in the current study are school and family connectedness. Previous research has linked both family connectedness and school connectedness with positive emotional health outcomes among adolescents. For example, in research with a nationwide sample of 7-12th grade youth, Resnick et al. (1997) found that both school and family connectedness were significantly related to less emotional distress. In another study with the same nationwide sample of 7-12th grade youth, Svetaz, Ireland and Blum (2000) found that high levels of school and family connectedness were related to less emotional distress in teens with and without learning disabilities. And, in this same sample of 7-12th graders, McNeely, Nonnemaker and Blum (2002) found that high levels of school connectedness were associated with greater emotional well-being and reduced risk for early sexual debut.

Pro-social connections to family and school may be especially important for teens faced with chronic environmental stressors, contributing to the development of emotional intelligence and stress management skills over time (Bernat & Resnick, 2006). The current study will examine variations in the levels of connectedness that adolescent girls from a vulnerable population report having with their families and schools. In particular, this study will assess whether high levels of these forms of social connectedness predict baseline levels of stress management skills and/or change in stress management skills over time.

Protective and risky health behaviors and emotional intelligence during adolescence. Low emotional intelligence has been linked with numerous adolescent risk behaviors, whereas high emotional intelligence has been associated with positive behaviors and socially desirable outcomes. Academic achievement and numerous positive attributes, including coping ability, moral development, altruism, courtesy, conscientiousness, leadership ability and other socially desirable behaviors have been found to be related to high levels of EI (Charbonneau & Nicol 2002a; Charbonneau & Nicol 2002b; Lee & Olszewski-Kubilius 2006; Peters et al., 2009) Additionally, greater emotional intelligence has been associated with better social functioning and higher levels of social support (Charbonneau & Nicol, 2002b; Ciarrochi et al., 2002; Ciarrochi, Wilson, Deane, & Rickwood, 2003). Due to the cross-sectional nature of previous research, it is unclear whether high levels of social support lead to trajectories of increasing EI or if adolescents with high levels of emotional intelligence are better at forming social relationships. There may also be a reciprocal relationship between emotional intelligence and social functioning and support.

Adolescent risk behaviors found to be significantly related to lower emotional intelligence include addiction-related behaviors, gambling, alcohol and tobacco use (Parker et al., 2008; Trinidad & Johnson, 2002). There is a paucity of information regarding relationships between sexual risk behaviors and emotional intelligence.

Sexual Behaviors and Emotional Intelligence

There are clear reasons why it is important to understand and reduce high risk sexual behaviors among U.S. adolescents. According to the CDC (2009), in 2004 there were approximately 745,000 pregnancies in females under the age of 20 in the U.S. The U.S. leads other industrialized nations in rates of adolescent pregnancies (Bearinger, Sieving, Ferguson, & Sharma, 2007). While teens and young adults make up only 25% of the sexually active population in the U.S., they account for approximately half of all newly diagnosed sexually transmitted infections (STI; CDC, 2009; Weinstock, Berman,

& Cates, 2004). By any metric, the costs to individuals, families, and society associated with high risk sexual behaviors during adolescence are too great for our nation to ignore.

Understanding the development of EI in adolescent girls engaged in high risk sexual behaviors has the potential to inform future interventions to reduce sexual risk behaviors. Cognitive development is associated with sexual risk behaviors, with adolescents who have greater cognitive skills being less likely to have sex and more likely to use contraception (Kirby, 2007). As previously described, cognitive development allows teens to control emotional reactions and impulses, key aspects of stress management skills. It is plausible that stress management skills is a key cognitive skill which influences sexual risk behaviors.

The current study will examine whether selected sexual behaviors predict initial levels of EI and/or change in EI over 24 months time. An extensive literature review failed to uncover any studies linking sexual behaviors and emotional intelligence in adolescence. Examining a related concept, Ethier et al. (2006) found an association between high levels of emotional distress and greater numbers of sexual partners among adolescent girls.

This study includes two sexual behavior indicators: number of male sexual partners in the past 6 months and partner communication regarding sexual risk. Greater number of sexual partners increases increases adolescents' risk for STI (Kirby, 2007). Discussion with a sexual partner regarding sexual risk (e.g., "My partner and I never discuss contraception"; "The first time you and your current partner had sexual intercourse, did one of you use contraception?"; Widman, Welsh, McNulty, & Little, 2006, p. 895) is an important protective behavior for sexually active adolescents (Widman et al.). Having this type of conversation is related to more consistent contraceptive use, which can lead to decreased risk of pregnancy and STI (Widman et al.). Relationship satisfaction significantly predicts whether communication regarding sexual risk takes place (Widman et al.). It is likely that relationship satisfaction is related to a secure attachment style as described by Hazan and Shaver (1987). Thus, increased communication with a sexual partner regarding sexual risk may reflect greater relationship satisfaction which may, in turn, be most likely among teens with secure relationships attachment style and greater emotional intelligence skills.

Based on research findings to date, it is hypothesized that girls who have had greater numbers of recent male sex partners will have lower stress management skills at the beginning of the study and will exhibit less development in stress management skills over two years. It is also hypothesized that girls who communicate with their male sex partners regarding sexual risk will have greater stress management skills at the beginning of the study, with trajectories of stress management skills that increase over time.

Conclusion

Adolescence is a period of brain maturation and may be a key time for the development of emotional intelligence. Development of the limbic system, the brain's "emotion center", during this period is likely to be influenced by high-risk social and environmental contexts (Greenberg et al., 2007). Adolescents often develop high risk behaviors in the context of vulnerable and stressful environments (Bradley & Corwyn, 2002). Many of the girls in the current study live in unstable and stressful environments which may contribute to the high risk sexual behaviors in which these girls engaged (Secor-Turner et al., 2011). Due to the effects of chronic environmental stress on brain development, these girls may exhibit relatively low levels of emotional intelligence during early adolescence along with little, or no, development over time (Evans et al., 2011).

The current study also examines aspects of the girls' lives that support resilience and may promote healthy development of stress management skills over time. Social connectedness, including pro-social connections to school and family, has been linked with lower levels of emotional distress, greater emotional well-being and less risky sexual behaviors (McNeely et al., 2002; Resnick et al., 1997; Svetaz et al., 2000). Strong connections to school and family may be especially important to healthy development among individuals faced with chronic environmental stressors, like many of the girls in the current study (Bernat & Resnick, 2006). Discussion with a partner regarding sexual risk is a protective behavior, indicative of a more satisfactory romantic relationship, which may be related to greater stress management skills (Widman et al., 2006).

The current study extends previous cross-sectional research on emotional intelligence by incorporating a longitudinal design to examine the development of stress management skills over time. It examines the development of stress management skills within a vulnerable group of adolescents, a population for whom the development of emotional intelligence is unexamined. Thus, the current study will further knowledge about the role of risk and protective factors in development of emotional intelligence during adolescence.

Chapter III: Methods

This study, a secondary analysis of data from the *Prime Time* intervention study, examined a component of emotional intelligence, stress management skills, over two years' time among a group of adolescent girls (ages 13 to 19) at high risk for early pregnancy and sexually transmitted infections (STI). This study employed girls' self-report measures of social connectedness and sexual risk behaviors collected at study initiation along with self-report measures of stress management skills collected at baseline (defined throughout this chapter as the initial episode of measurement for girls in each age cohort, which included girls at age 13, 14, 15, 16, and 17) and at 6-month intervals over a 2-year period of time. Specific measures included perceived connectedness to family and school, communication with most recent male sexual partner regarding sexual risk, the number of male sexual partners in the past six months, and stress management skills. This chapter will outline the specific aims of this study; the research design for both *Prime Time* and the current study; characteristics of the *Prime Time* study sample and the sample for the current study; core study variables and their measurement; and the analysis plan for the current study.

Specific Aims

The main purpose of this study was to determine if development occurs in one aspect of emotional intelligence, i.e., stress management skills, over time in girls who engage in high risk sexual behaviors. This study utilized an accelerated cohort design to determine if change occurred over time.

Employing data from the *Prime Time* study, the specific aims of this study were to:

1. Describe baseline (the first survey occasion for each participant) stress management skills and study predictors (family connectedness, school connectedness, partner communication regarding sexual risk, and number of male sex partners in the past six months) and relationships among these variables.
2. Describe stress management skills at five time points over 24 months, exploring initial level of stress management skills and functional form of change in both individuals and age cohorts over time.
3. Using data from an accelerated cohort design, model normative change in stress management skills linking growth curve segments from each age cohort (from ages 14 to 19 years).
4. Use indicators of social connectedness and sexual behavior at the first survey occasion to model the level of stress management skills at age 14 and functional form of change in stress management skills from age 14 to age 19.

Design

To adequately examine normative development of emotional intelligence (EI), and specifically, stress management skills, across adolescence, it is important to use measures of stress management skills collected over an extended period of time. The *Prime Time* study was chosen for this secondary data analysis because the *Prime Time* participant survey instrument incorporated measures of emotional intelligence (including a measure of stress management skills) and participants completed this survey every 6 months for a 30-month period of time (the current study only uses the first 24 months of data). The *Prime Time* survey also measured constructs which may be useful in predicting stress management skills. These variables included connectedness to school, connectedness to family, partner communication regarding sexual risk, and the number of male sex partners in the past six months.

The current study examined one specific aspect of emotional intelligence, stress management skills, and employed measures of connectedness to school, connectedness to family, partner communication regarding sexual risk, and the number of male sex partners in the 6 months prior to the beginning of the study as potential predictors of baseline levels (in the current study, baseline is defined as the first survey occasion for each participant, regardless of age) of stress management skills and change in stress management skills over a 24 month period of time. Capitalizing on the age variability within the *Prime Time* sample, with participants ages 13 – 17 years at the time of study enrollment, an accelerated cohort analysis approach was used to model the development of stress management skills. The accelerated cohort design was introducted by Bell in 1953 to "provide a means of actually linking up individuals or sub-groups between adjacent segments of a developmental curve, each segment consisting of a limited longitudinal study on a different age group" (p. 281), also known as a cohort. The accelerated cohort design "approximates a long-term longitudinal study by simultaneously conducting and connecting several short-term longitudinal studies of different age cohorts" (T.E. Duncan, S.C. Duncan, & Strycker, 2006, p. 93).

There are a number of advantages to using an accelerated cohort design, including a shorter follow-up time for several cohorts while still utilizing information over the longer period by combining information from each cohort (S.C. Duncan, T.E Duncan, & Hops, 1996; S.C. Duncan, T.E. Duncan, & Strycker, 2006; T.E. Duncan et al., 2006). Additionally, by examining stress management skills in participants from multiple age cohorts, it was possible to determine whether trends observed in one cohort were present in other cohorts for ages where the cohorts overlapped. The same trend present across cohorts would provide evidence that change in stress management skills is not limited to one cohort, but can be shown in multiple cohorts (S.C. Duncan et al., 1996). This evidence is not traditionally available in longitudinal studies and provides a comparatively powerful method for studying development (Miyazaki & Raudenbush, 2000).

Another strength of the accelerated cohort design is that it reduces the need to number of measurement occasions for any one individual. Requiring relatively fewer occasions of measurement than a traditional longitudinal study may reduce participant attrition and the possibility of panel conditioning. Panel conditioning is the risk that the measurement itself becomes an intervention, with participants responding differently to questions at later time points, based solely on the fact that they have been exposed to these questions before and gotten better at responding or have figured out what a more socially desirable response would be. With an accelerated cohort design participants are surveyed over a shorter period of time and, thus, will not have as much of an opportunity to become accustomed to the questions.

In order to examine age cohorts in the accelerated cohort design, participants were separated into age cohorts by subtracting each girl's birth date from the date of the survey. The ages were then truncated to year, giving the following age cohorts: 13, 14, 15, 16, and 17.

Population and Sample

The current study utilized self-report data from participants assigned to a control group in a study of *Prime Time*. This intervention study involved sexually active 13-17 year old girls recruited from four school and community-based clinics. Age-eligible girls were identified by clinic staff and referred to clinic-based research staff to determine eligibility for study participation. Sexually active 13-17 year old girls who met one or more of six risk criteria were eligible to participate in the *Prime Time* study. These risk criteria included: clinic visit involving a negative pregnancy test; clinic visit involving treatment for sexually transmitted infection; young age (13-14 years); high risk sexual and contraceptive behaviors; behaviors indicating school disconnection; and aggressive and violent behaviors. Assessed through a 20-item self-report screening instrument, the behavioral criteria were designed to identify teens with multiple and complex needs (Sieving, Resnick et al., 2011).

The *Prime Time* study utilized a "wash-in" strategy to reduce study attrition. Study-eligible teens were identified at an initial visit to the clinic; those who agreed to participate were asked to return to the clinic for a second study visit within two weeks (Sieving, Resnick et al., 2011). This strategy was employed to reduce loss-to-follow-up often seen in teen pregnancy prevention studies, where many participants are lost immediately after study enrollment (Kirby, 2001; Stevens-Simon, 1995). Written informed consent was obtained at the second study visit. Participants also completed a baseline study survey using an audio-computer assisted self-interview (A-CASI) method. Following completion of the baseline survey, participants were randomized to either the intervention or control condition (Sieving, Resnick, et al., 2011).

A total of 253 adolescents agreed to *Prime Time* study participation, completed baseline data collection, and randomization. This sample was ethnically and racially diverse. A comparison of intervention and control groups at baseline revealed no significant differences between groups in demographic characteristics or risk behaviors (Sieving, McMorris, et al., 2011). Intervention participants were involved in *Prime Time* programming over 18 months; control participants continued to receive usual clinic services. All participants completed an A-CASI survey at baseline and every 6 months for a period of 30 months (the current study utilized only the first 24 months of data; Sieving, Resnick, et al., 2011).

This secondary analysis utilized survey data from girls who were assigned to the control condition of the *Prime Time* study. This allowed for examination of the natural course of emotional intelligence development in girls at high risk for early pregnancy and STI without intervention effects. The inclusion criteria for this study were *Prime Time* participants who: (a) were randomly assigned to the control condition; (b) completed the first (baseline) *Prime Time* survey and answered at least one item from each of the following measures: family connectedness scale, school connectedness scale, partner communication regarding sexual risk scale; (c) reported the number of male sex partners in past six months at the time of enrollment; and (d) reported stress management skills on at least one occasion of measurement. *Prime Time* control group participants were excluded from this study if they: (a) did not respond to at least one item on the family connectedness, school connectedness, and partner communication regarding sexual risk scales; (b) did not report how many male sex partners they had in the past six months at the time of enrollment; and (c) did not respond to at least one item on the stress management skills scale over the five survey occasions.

A total of 127 participants were randomly assigned to the *Prime Time* control condition. Of the 127, two participants were missing responses on variables of interest and were therefore excluded from this study. Thus, the final sample for the current study was composed of 125 participants.

Demographic characteristics of the study sample. The sample of girls in the current study was, on average, 16 years old at baseline. As noted in Table 3.1, this sample was ethnically and racially diverse. Over half of these girls reported that their families had received public assistance in the past year. Almost 40% lived in two or more places in the past six months, reflecting a population who is economically disadvantaged with residential instability. Another measure of stability in these girls' lives was the number of school changes each had experienced: a high percentage (40%) had changed schools one or more times in the past year (not related to transitions between elementary, middle, and senior high school). Table 3.1 provides further information on sample characteristics.

Table 3.1

Demographic Characteristics of Study Sample (N = 125)

Characteristic	N (%)
Race/Ethnicity	
Black (African American)	47 (37.6)
White (European)	20 (16.0)
Asian or Pacific Islander	17 (13.6)
Hispanic or Latino	10 (8.0)
American Indian	3 (2.4)
Multiple ethnicities	28 (22.4)
Family Receipt of Public Assistance, Past Year	
No	39 (31.2)
Yes	64 (51.2)
Don't know	22 (17.6)
Number of Parents Lived With	
No parents	3 (2.4)
1 Parent	54 (43.2)
2 Parents	58 (46.4)
Other	10 (8.0)
Number of Places Lived, Past 6 Months	
1 Place	76 (60.8)
2 Places	30 (24.0)
3 Or more places	19 (15.2)
Currently in School	
Yes	120 (96.0)
No	5 (4.0)
Number of Schools Attended, Past Year	
1 School	70 (56.0)
2 Schools	27 (21.6)
3 or more schools	23 (18.4)
Age	
Mean age at baseline	16.05
Age range at baseline	13.4 – 17.95
Age in Years at Baseline	
13	3 (2.4)
14	27 (21.6)
15	30 (24.0)
16	35 (28.0)
17	30 (24.0)

Variables and Measurement

Emotional intelligence: Stress management skills. Stress management skills was measured using the Bar-On Emotional Quotient Inventory, youth version, short form (Bar-On EQ-i:YV(s), Bar-On & Parker, 2000). For the current study, the main variable of interest was stress management skills as measured by the Stress Management Skills Scale. This scale is comprised of six items (Table 3.2) and, according to Bar-On and Parker, is designed to measure two related abilities: "a) stress tolerance, the ability to withstand adverse events and stressful situations without falling apart by actively and positively coping with stress; and b) impulse control, the ability to resist or delay an impulse and to control one's emotions" (p. 34). Responses to all items in this scale were reverse coded so that higher scores reflected greater ability to manage stress. The mean score was used as the scale score for each individual based on all available data. The internal consistency reliability at study baseline among girls in the current study sample was high ($\alpha = 0.83$, $N = 125$).

Table 3.2

Stress Management Skills Scale Items

Items	Response Options
1. I get too upset about things.	
2. I fight with people.	1 = Never or seldom
3. I have a temper.	2 = Sometimes
4. When I am mad at someone, I stay mad for a long time.	3 = Often
5. I get upset easily.	4 = Very often
6. When I get angry, I act without thinking.	

Note. Responses were recoded for all items so that a higher score indicates greater skill.

Social connectedness indicators.

School connectedness. School connectedness can be defined as the perception that teachers treat you fairly, that you are both a part of your school and close to other people at your school (Resnick et al., 1997). Nine items represented the degree to which individuals felt connected to school; items and response options are seen in Table 3.3. These items were coded so that a higher score indicated a greater degree of school connection. The mean of item responses was used as an individual's scale score. The internal consistency reliability of this scale at baseline among this study sample was high ($\alpha = 0.83$, $N = 125$).

Family connectedness. Family connectedness includes feeling close to one's family, feeling that parents care for and about you, and feeling loved and wanted by family members (Resnick et al., 1997). Five items made up the scale used in the *Prime Time* survey (Table 3.3). A higher score indicated a higher level of family connectedness. The mean of item responses was used as an individual's scale score.

Table 3.3

Measurement of Covariates

Variable	Items	Response Options
School Connectedness	1. I have friends at school 2. Adults in my school care about me 3. The teachers at my school treat students fairly 4. The teachers at my school care about students 5. My teachers respect me 6. I get along with my teachers	1 = None 2 = A little 3 = some 4 = A lot
	1. My teachers expect me to do well 2. I feel like I belong at my school 3. I get along with other students	1 = Never or seldom 2 = Sometimes 3 = Often 4 = Very often
Family Connectedness	1. My family understands me 2. My family has fun together 3. My family pays attention to me 4. I feel close to my family 5. My family cares about me	1 = Not at all 2 = A little 3 = Some 4 = A lot
Partner Communication Regarding Sexual Risk	When did you and [initials of most recent sex partner] talk about… 1. …when you should have sex for the first time? 2. …using condoms? 3. …using other types of birth control (pill, patch, depo)? 4. …how to keep from getting HIV, AIDS, or other STIs? 5. …previous sexual partners (yours & his)? 6. …whether it's okay to have sex with other people? 7. …how to keep from getting pregnant?	0 = Never 1 = After 2 = Before

This scale showed high internal consistency reliability at baseline among the current study sample ($\alpha = 0.92$, $N = 125$).

Sexual behavior indicators.

Partner communication regarding sexual risk. Reports of communicating with the most recent partner regarding sexual risk were used as a proxy for protective sexual behaviors in the current study, with earlier discussion related to more positive and healthier behavior. Seven items measured participants' communication about sexual risk (Sieving, McMorris et al., 2011, Table 3.3). Girls could respond to these items for up to four male sex partners over the past 6 months. For purposes of this study, only reports regarding the most recent male sex partner were used. Participants reported when they talked with their most recent partner about aspects of sexual risk including using condoms and other contraception, preventing pregnancy, STI and HIV/AIDS. Each item had three response options: *we **never** talked about this; we talked about this **after** we had sex;* and *we talked about this **before** we had sex*. Items were coded such that a higher score indicated earlier discussion between the participant and her sex partner. The mean of item responses was used as an individual's scale score. The internal consistency reliability of this scale at baseline was $\alpha = 0.73$ ($N = 125$).

Number of male sex partners in past six months. Number of male sex partners in the 6 months prior to the first survey was used as a proxy for sexual risk behaviors in the current study because a greater number of sexual partners, especially in a short period of time is related to higher risk for early pregnancy and STIs. Number of male sex partners in the past 6 months was determined by responses to a question on two surveys, "In the last 6 months, how many males have you had sex with (his penis in your vagina)?" Responses to this item could range from 1 to 99 partners (girls had to report at least one male sex partner in the past six months to be eligible to participate in the *Prime Time* study). The number of sex partners was determined by taking the average from the screening tool completed at the first study visit (which was used to determine participant eligibility) and from the baseline survey. The average was used due to missing responses on the baseline survey and minor discrepancies between answers at these two time points.

Human Subjects Protection, Data Management and Security

Secondary analysis of *Prime Time* data for the current study was approved by the University of Minnesota Institutional Review Board as an exempt study (see Appendix A for approval documentation). The study was exempt from full IRB review because of the use of secondary data. The data were de-identified, with participants identified by study ID only, prior to receipt by the principal investigator (PI). The PI did not have access to files linking participants' names with study IDs. All analyses with the de-identified data set were conducted by the PI on a password-protected computer.

Analysis Plan

The study's analysis plan is described by specific aim. Descriptions of study variables as well as relationships among these variables (aim 1) and the initial data analysis (aim 2) were all accomplished using SPSS Statistics Version 19.0. Latent growth modeling using an accelerated cohort design (aim 3), including indicators of social connectedness and sexual behavior (aim 4), was completed using M*plus* software (Muthén & Muthén, 1998-2010).

Aim 1. Descriptive statistics for the predictor variables at baseline were examined by cohort and for the entire sample. These analyses included measures of central tendency, range, standard deviation, and reliability for each scale. Baseline relationships between the predictor variables and the stress management skills scale were also examined by cohort and for the entire sample. Bivariate relationships among the following scales were analyzed utilizing Pearson's *r*: school connectedness, family connectedness, partner communication regarding sexual risk, and stress management skills. Bivariate relationships between the number of male sex partners in the past six months and the other study variables were examined using Spearman's *ρ*, which is appropriate with measures that have discrete values.

Aim 2. To describe stress management skills over all time points, an initial data analysis (also known as a descriptive exploratory analysis) examined how girls in this sample changed over time both as individuals and as age cohorts. This exploration of the data allowed for examining how individuals changed over time and for observing general patterns of change, which served as preparation for the model-based analyses undertaken to address Specific Aim 3 (Singer & Willett, 2003).

Individual change. According to Singer and Willett (2003): "The simplest way of visualizing how a person changes over time is to examine an *empirical growth plot*, a temporally sequenced graph of his or her empirical growth record" (p. 23). Empirical growth plots were created for each girl in the sample. These growth plots showed individual change in stress management skills over time. Additionally, these growth plots allowed for preliminary examination of the rate of change for girls who had increasing or decreasing scores. Plots were compared to look for differences among individuals.

The first step of the analysis was to create empirical growth plots using a nonparametric smoothing technique. This allowed the "data to speak for themselves" without artificially forcing into a predetermined form (Singer & Willett, 2003). The second step was to create tentative models for growth by fitting a linear regression. No-change and preliminary quadratic models for change were also fit to the data. This was done through fitting regression models to each girl's data which yielded parameters summarizing individual trajectories (Singer & Willett). Ordinary least squares (OLS) regression was used to fit individual trajectories. The regression model was then superimposed on the empirical growth plots to visualize the difference between predicted change based on the fitted model and actual change. Additionally, SPSS provided summary statistics regarding the goodness of fit of each fitted model with the observed change through R^2 and residual variance statistics. The fit statistics helped determine whether a linear or quadratic model best fit the data.

According to Singer and Willett (2003), exploratory analyses often show that different people change differently over time, and thus, the best fit would be acquired by using different functions. In the current study some participants appeared to have a constant rate of change over time (linear change) while other participants appeared to have rates of change that varied over time (quadratic change). However, it is important to choose a single function to describe change in all participants. Parsimony is desired when choosing a model, making a linear model ideal if it appears to fit the data (Singer &

Willett). A linear model is the simplest way to model change, because it consists of a straight line and can be described using two terms, intercept and slope. Ultimately, quadratic change was still modeled, but it was important to consider the advantages of a linear model when determining the best model in aim 3.

Change by cohort. Group level change was examined by separating girls into age cohorts, to see group change in each cohort. Separate graphs were created using nonparametric smoothing and fitted OLS regression techniques. Graphs were visually examined to compare change across cohorts.

Aim 3. Analysis of individual and age cohort change, from aim 2, provided evidence of change in stress management skills over time in at least some of the girls within this sample. In addition, there appeared to be different types of change occurring across individuals, with goodness of fit statistics lending evidence to the presence of both linear and quadratic growth (Table 3.4 shows R^2 for models with quadratic term vs. without it). As can be seen in Table 3.4, the modal R^2 value for the linear change model was between 0 and .1, indicating that the linear model for change did not account for intra-individual variability for many of the individuals in the study sample.

Accelerated cohort design. The objective of aim 3 was to estimate parameters of a normative growth model for stress management skills across adolescence in girls who engage in high risk sexual behaviors.. Participants began this study at a range of ages from early adolescence (age 13), to later adolescence, nearing the age of 18. Over the 2 years of the study, participants' ages ranged between 13 and 19 years.

Linear	R^2	**Quadratic**
	1.0	0000
3	0.9	11123345667888
9542200	0.8	01112233445556778
8776665533333200	0.7	0134566777778888899
76663110	0.6	123566778999
954422110	0.5	02223444569
99987666500	0.4	01111456779
97554210	0.3	006678
932110000	0.2	11347
888654322000	0.1	000112245789
99998887766665544443322211111100000000000	0.0	001124557889

Figure 3.1. Stem-and-leaf plot of R^2 statistics comparing goodness-of-fit between linear and quadratic models ($N = 123$).

In order to accurately model the mean change trajectory of participants across this span of development, an accelerated cohort design was used.

The first step in creating a growth model of stress management skills using an accelerated cohort design approach was to determine whether it was reasonable to assume that participants were drawn from the same population and that there would be convergence among the growth curves for each age cohort, allowing for creation of an overall model of growth. Since all girls in this study met the same inclusion and exclusion criteria and were living in the same urban area of the upper Midwest at the time of this study, it was highly likely that they were drawn from the same population of girls engaged high risk sexual behaviors who seek clinical services. Thus, it was theoretically plausible that the girls were all from the same population (or girls with variation around the same mean growth parameters for stress management skills), making it reasonable to believe that the same underlying growth curve would be present across the different age cohorts.

After deciding that it was theoretically reasonable to assume that the girls in the study sample came from the same population, the next step was to group the data collected from participants into age cohorts. To have cohorts which had large enough numbers of participants to study change over time, each participant's age was truncated to year. There were only three participants in the age 13 cohort, which was not enough for growth curve modeling, therefore the first cohort was the age cohort 14. There were a total of four cohorts (age 14, age 15, age 16 and age 17, *N* = 122). This resulted in four growth curves, with each curve displaying a summary of how girls in this age group changed over a 2-year period. In order to combine growth curves from multiple cohorts, it was important that there were overlapping ages between cohorts. For example, participants who began at age 14 and ended at age 16, were surveyed every six months and would have three ages that overlapped with girls who began at age 15: 15, 15.5, and 16 years; girls beginning at age 15 would have three overlapping points with girls beginning at age 16, and so on (displayed in Table 3.5). These overlapping age points allowed for testing convergence and for creating a common model of growth spanning the ages 14 to 19 years (S.C. Duncan et al., 1996; Mehta & West, 2000). Without overlapping age points, it would be impossible to determine if differences in scores were due to age-related development or because the samples were drawn from different populations.

Table 3.5

Ages Across Cohorts

Age Cohort	*N*	Age 14	14.5	15	15.5	16	16.5	17	17.5	18	18.5	19
14	27	0 M	6 M	12 M	18 M	24 M	–	–	–	–	–	–
15	30	–	–	0 M	6 M	12 M	18 M	24 M	–	–	–	–
16	35	–	–	–	–	0 M	6 M	12 M	18 M	24 M	–	–
17	30	–	–	–	–	–	–	0 M	6 M	12 M	18 M	24 M

Latent growth model. Latent growth models were used in the accelerated cohort design. The overall path model is presented in Figure 3.2, with path models for each cohort shown in Figures 3.3 through 3.6. All of these path models depict linear growth. Models of no change and quadratic growth were also tested; these are described and pictured later.

Conventional latent variable growth modeling equations are used to describe the overall path model in Figure 3.2 (Li, T.E. Duncan, S.C. Duncan, & Acock, 2001). The individual stress management skills trajectories were defined by the following equation of a linear latent growth model for the continuous observed variable, **y**, with continuous latent variable $\boldsymbol{\eta}$, for individual *i* across $p = 5$ survey time points:

$$\mathbf{y}_i = \boldsymbol{\Lambda}_y \boldsymbol{\eta}_i + \boldsymbol{\varepsilon}_i, \qquad (1)$$

where $\mathbf{y}_i$ is a p x 1 vector of repeated measures containing scores for individual *i* at each survey time point *p*. $\boldsymbol{\Lambda}_y$ is a p x m matrix (5 x 2 for the linear model with 5 measurement time points) of factor loadings, also called the basis term (Li et al., 2000; McArdle &

Hamagami, 1991). In equation 1, the $\mathbf{\Lambda}_y$ matrix contains a column of 1's for the intercept factor (η_0) and another column for the values of time that define the slope factor (η_s) (Li et al., 2001). $\boldsymbol{\eta}_i$ is a *m* x 1 vector of latent variables, which contains the growth factors (or change parameters) for individual *i*; for the linear model this contained the intercept and slope growth factors making it a 2 x 1 vector, but it also contained the coefficients for the intercept-only (no-growth, 1x1) and quadratic (3 x 1) vectors (Li et al., 2001; Li, T.E. Duncan, Mcauley, Harmer, & Smolkowski, 2000). The intercept factor loadings (column 1 of the $\mathbf{\Lambda}_y$ matrix; $\boldsymbol{\lambda}_{11}, \ldots, \boldsymbol{\lambda}_{51}$) for all five measurement time points, were fixed at 1.0. In order to capture change across the different cohorts for the linear model, the slope factor loadings (column 2 of the $\mathbf{\Lambda}_y$ matrix; $\boldsymbol{\lambda}_{12}, \ldots, \boldsymbol{\lambda}_{52}$) were fixed to correspond to measurement time points in six month intervals, with age centered at 14. Specific factor loadings for each age cohort can be seen in Figures 3.3-3.6. The vector $\boldsymbol{\varepsilon}_i$ contains error terms, indicating error in measurement for individual *i*, which is the deviation of the data point at time *t* from the growth model for individual *i.* These specific residual terms within each occasion of measurement are denoted ε_1 through ε_5.

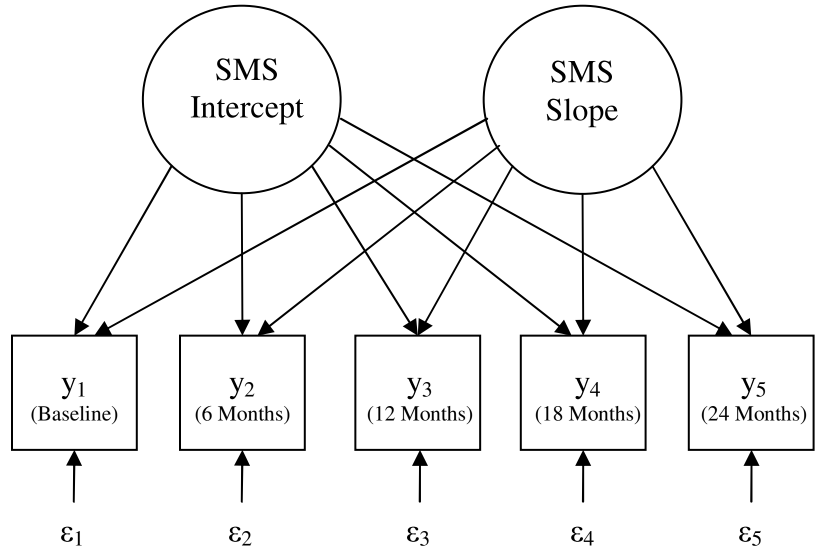

Figure 3.2. Overall linear path model describing stress management skills over five time points. Age at baseline shifts for each cohort. SMS = stress management skills.

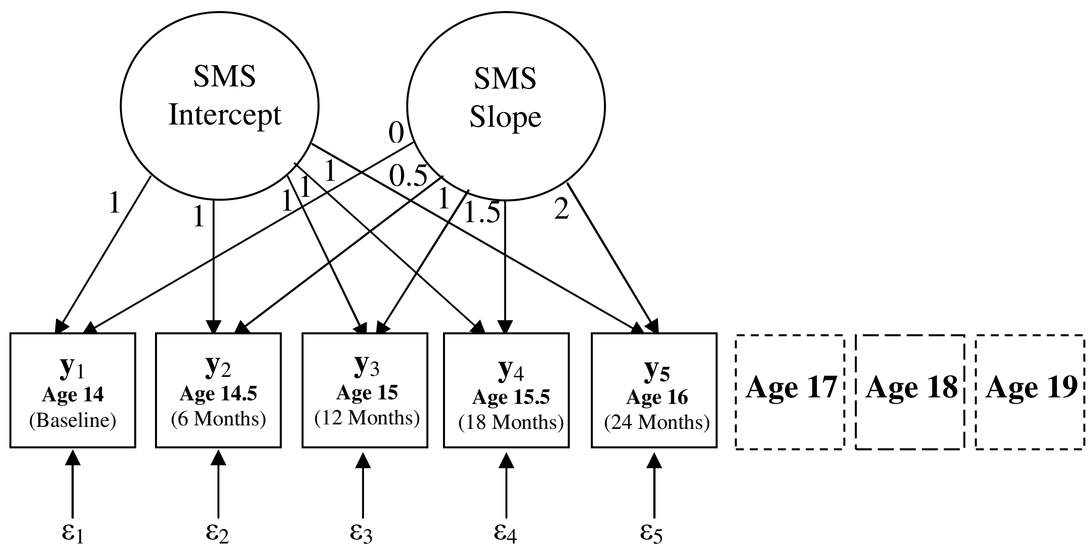

Figure 3.3. Age cohort 14 linear path model describing stress management skills from ages 14 through 16. Age at baseline shifts for each cohort. SMS = stress management skills.

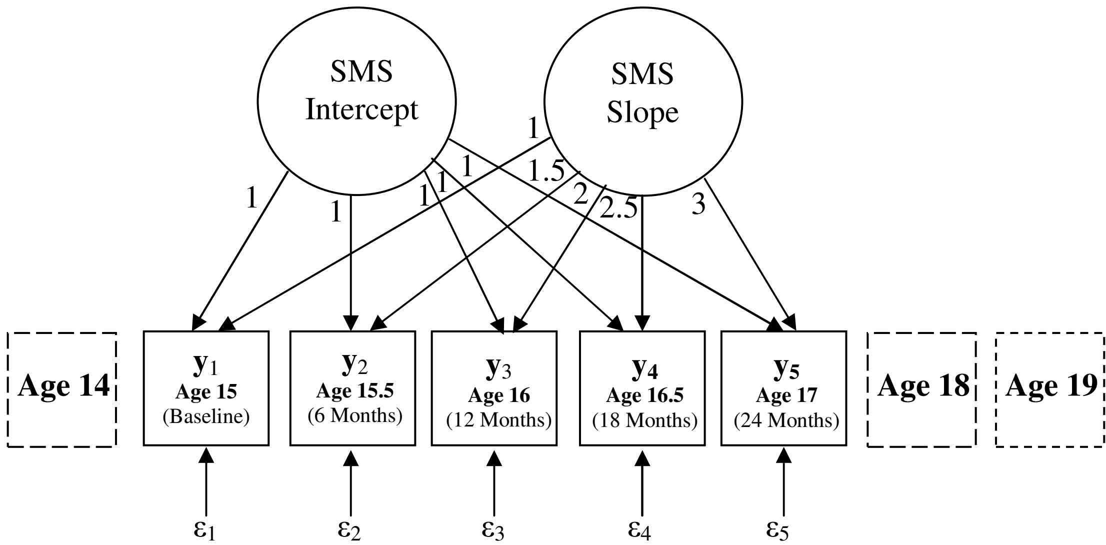

Figure 3.4. Age cohort 15 linear path model describing stress management skills from ages 15 through 17. Age at baseline shifts for each cohort. SMS = stress management skills.

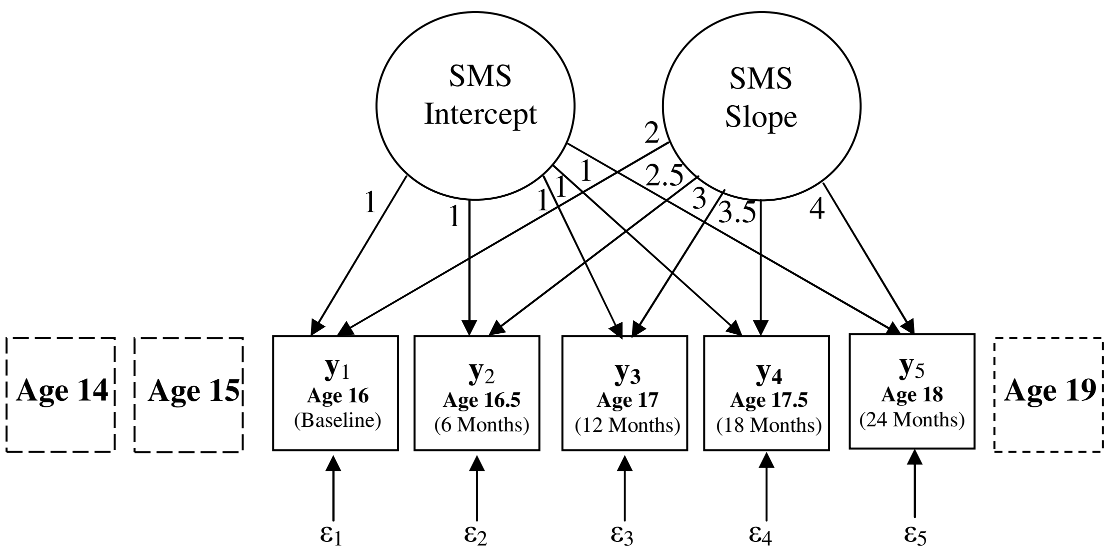

Figure 3.5. Age cohort 16 linear path model describing stress management skills from ages 16 through 18. Age at baseline shifts for each cohort. SMS = stress management skills.

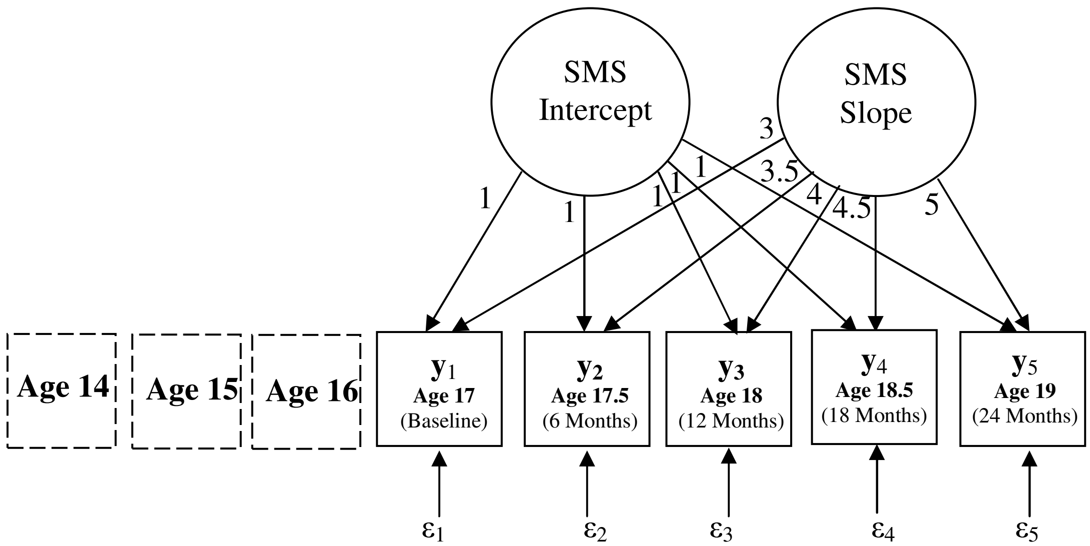

Figure 3.6. Age cohort 17 linear path model describing stress management skills from ages 17 through 19. Age at baseline shifts for each cohort. SMS = stress management skills.

The age variable for all cohorts was anchored at a common origin, age 14 (Mehta & West, 2000). This allowed the time measurement to begin at 0 for age 14 and increase by increments of 0.5 every 6 months. Following the formulation described by Mehta and West, this was accomplished by fixing the loading for the slope factor (λ_{12}) at 0 for the first occasion of measurement for the age 14 cohort. All other slope factor loadings for all cohorts represent the deviation of the measurement from age 14 in increments of half years. For example, the age 15 cohort began with slope factor loading (λ_{12}) at 1.0, representing a deviation of one year from the origin of age 14. The second measurement point (the 6-month survey) for the age 15 cohort, had the slope factor loading (λ_{13}) of 1.5, because it was one and a half years beyond the origin of age 14. This means that slope factor loadings were identical where the cohorts overlapped (Mehta & West). For example, the 12-month survey for the age 14 cohort had the same factor loading as the baseline survey for the age 15 cohort, and both were equal to 1. The final parameter in Equation 1 is the $\boldsymbol{\varepsilon}_i$ vector, which is a p x 1 vector of the measurement error (residual) for each occasion of measurement for individual i.

The following equation defines the individual growth parameter vector, $\boldsymbol{\eta}_i$ (m x 1), described above:

$$\boldsymbol{\eta}_i = \boldsymbol{\alpha} + \mathbf{B}\boldsymbol{\eta}_i + \boldsymbol{\zeta}_i, \quad (2)$$

where $\boldsymbol{\alpha}$ is a m x 1 vector containing the latent growth factor means for all growth parameters, in this case for the linear model, intercept and slope, (μ_0, μ_s); **B** is a null matrix, and $\boldsymbol{\zeta}_i$ is a vector of individual deviations from the mean growth parameters (Li et al., 2000; Li et al., 2001). $\boldsymbol{\zeta}$s, indicates the residual variability around the growth curve across individuals that is unaccounted for by stress management skills and the growth model (Biesanz, Deeb-Sossa, Papadakis, Bollen, & Curran, 2004)

Certain assumptions were required for modeling the data using the accelerated cohort design. Elements in the $\boldsymbol{\varepsilon}_i$ vector were assumed to have a multivariate normal distribution, mean equal to zero, and variance σ^2. Elements in the $\boldsymbol{\zeta}_i$ vector were also assumed to have a mean equal to zero and multivariate normal distributions with the covariance matrix $\boldsymbol{\Psi}$. $\boldsymbol{\Psi}$ is a m x m matrix with variances of the individual growth parameters contained in the diagonal elements and covariances of the individual growth parameters contained in the off-diagonal elements (Li et al., 2000). Correlations among the growth parameters are obtained by rescaling the $\mathbf{\Psi}$ matrix, which M*plus* does automatically (Muthén & Muthén, 1998-2010)

No-change and quadratic models. The no-change and quadratic models are similar to the equations described above and are depicted in Figures 3.7 and 3.8, respectively. The no-change model is an intercept-only equation, and assumes that there was no change in stress management skills scores over time. Changes occurred to the $\mathbf{\Lambda}$ matrix, due to the presence of only one factor, the intercept factor, $\boldsymbol{\eta}_0$, this became a 5 x 1 matrix. The $\boldsymbol{\eta}_i$ vector was also changed for the same reason, and with the removal of the second column for the slope factor, became a 1x1 vector. In the second equation the $\boldsymbol{\alpha}$ vector only contained the factor mean for the intercept.

The quadratic model assumes a more complicated form of growth. A quadratic term indicates that an individual's growth changes differently over time, experiencing change in the rate of change over time. The analyses conducted for Study Aim 2, utilizing R^2 as a goodness of fit statistic to compare the quadratic and linear growth models (see the stem and leaf plot comparing R^2 between these two types of models in Table 3.6), suggested that some participants changed in this way (Singer & Willett, 2003). The quadratic model had changes to the same matrices and vectors as the no-change/intercept-only model. In the first equation, the $\mathbf{\Lambda}$ matrix contained a third growth factor in a third column, $\boldsymbol{\eta}_q$ and became a 5 x 3 matrix. The factor loadings for $\boldsymbol{\eta}_q$ ($\boldsymbol{\lambda}_{13}, \ldots, \boldsymbol{\lambda}_{53}$) were fixed and were calculated by squaring the slope factor loadings (time of observation, $\boldsymbol{\eta}_s^2$). For the quadratic model the $\boldsymbol{\eta}$ vector contained the quadratic growth factor, in addition to the intercept and slope growth factors, making it a 3 x 1 vector. In the second equation $\boldsymbol{\alpha}$ contained the additional latent growth factor mean for the quadratic term ($\boldsymbol{\alpha}_q$).

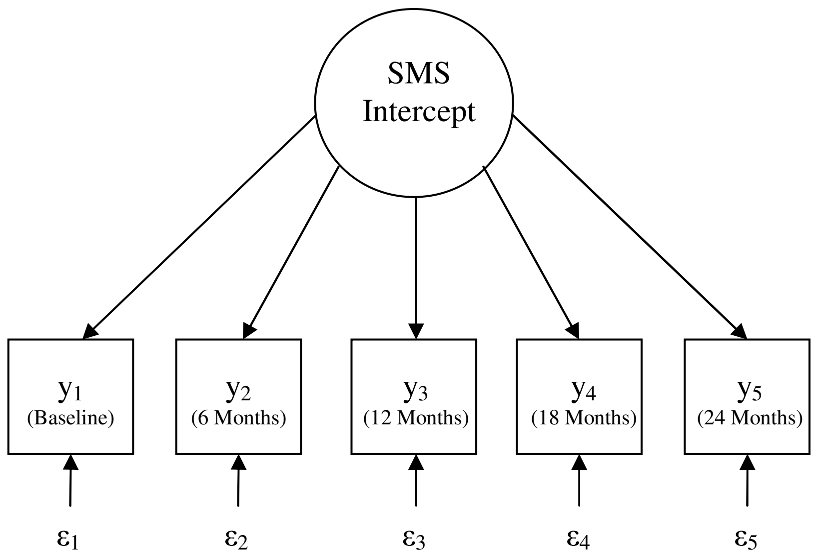

Figure 3.7. Overall no-change path model describing stress management skills over five time points. Age at baseline shifts for each age cohort. SMS = stress management skills.

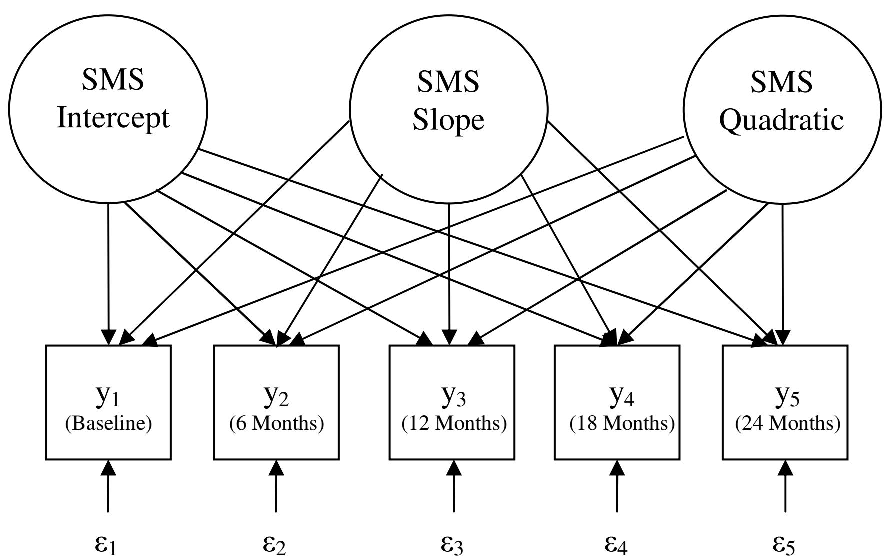

Figure 3.8. Overall quadratic path model describing stress management skills over five time points. Age at baseline shifts for each age cohort. SMS = stress management skills.

Testing for convergence across age cohorts. Testing for convergence of growth models across cohorts is an important component of the accelerated cohort design. This test helps determine whether participants came from the same population, across cohorts and answers the question “can a single line or curve be used to represent the information from all age cohorts?” In other words, this is a test for an age x cohort interaction effect, which could pose a threat to valid inferences regarding the development of stress management skills from age 14 to 19 (Miyazaki & Raudenbush, 2000). This type of interaction effect could occur if there were theoretically important demographic differences between cohorts or as an effect of history (Miyazaki & Raudenbush). Determining that the age cohorts came from the same underlying population with respect to change in stress management skills, i.e., that the cohorts converged, lends more power to the conclusion that changes in stress management skills were due to development related to age. Convergence across cohorts must be determined with each type of model (no-growth, linear, and quadratic; Anderson, 1993; Orth, Trzesniewski, & Robins, 2010). In order to treat this as an overall growth curve that can be modeled, it must be determined that the data come from the same underlying population and that a common growth curve exists. Using M*plus,* it was possible to build the overall growth curve by utilizing information from all cohorts simultaneously (Muthén & Muthén, 1998-2010). Each age cohort contributed a different section to the overall growth curve and also had a different pattern of “missingness”, which permits the estimation of missing data by treating it as a latent variable (S.C. Duncan, T.E. Duncan, & Strycker, 2006). According to Anderson: “Because only some of the data describing the curve is missing or latent for a given age group [cohort], the model is identified and it is possible to build the complete curve by using information from all groups simultaneously" (p. 931).

The parameters of growth (intercepts, slopes, variances, and error terms) must be equal across cohorts for the common ages in order to determine whether the model of convergence provides a better fit to the data than separate models for each cohort (Anderson, 1993; T.E. Duncan, S.C. Duncan, & Hops, 1994). These parameters were first examined visually, across cohorts. The next step was to develop a table of weighted means for common ages across cohorts. These means were used to create an initial growth trajectory, prior to statistically testing for convergence across cohorts.

Next, convergence was tested for each type of growth model utilizing equality constraints on all parameters, forcing the mean intercepts, mean slopes, variance of intercepts, variance of slopes, and error terms to be equivalent across all four cohorts, using M*plus* software (Muthén & Muthén, 1998-2010). The constrained models were then compared with models where these parameters were allowed to vary freely between age cohorts. Using model fit statistics, it was possible to determine whether a constrained model was a better fit to the data than a model in which the coefficients were freely estimated (Orth et al., 2010). The χ^2 test statistic, Akaike Information Criterion (AIC), Bayes Information Criterion (BIC), and the root mean square error of approximation (RMSEA), explained on page 78 were used to compare the fit between the constrained and free models, testing the hypothesis that a common curve existed across cohorts. A successfully converged curve shows that individuals across cohorts generally follow the same average pattern of development (T.E. Duncan et al., 1994). Model fit statistics supporting the constrained model would provide good evidence that this accelerated cohort design had approximated a true longitudinal study and that the girls have been sampled from the same “true longitudinal population” (S.C. Duncan et al., 2006, p. 76). If the test of convergence failed (i.e., model fit statistics indicate that a model with freely estimated parameters better fits the data), at least one age cohort could be thought of as following a different pattern of development, which would imply an age x cohort interaction, as described previously (T.E. Duncan et al., 1994; Miyazaki & Raudenbush, 2000).

Modeling plan. An accelerated cohort design utilizing latent growth modeling was used to estimate a common growth curve of stress management skills in age cohorts of girls who engage in high risk sexual behaviors. The use of latent growth modeling means that group change and individual differences in change could be modeled over time (Li et al., 2000). The accelerated cohort design models were estimated in M*plus* using a multiple-group context (S.C. Duncan et al., 2006; Muthén & Muthén, 1998-2010). The purpose of aim 3 was to create growth models of stress management skills using accelerated cohort design and to choose a model that best described the change in stress management skills over time. Based on the initial data analysis for aim 2, three unconditional forms of change were modeled (no-growth, linear growth, and quadratic growth). Each form of change was modeled and then compared with others to find the form that best fit the data from this group of girls. Model 1 was the no-growth model, Model 2 was the linear model, and Model 3 represented the quadratic model (Figures 3.2-3.8). These models were estimated within a multiple-group context, assuming the same growth model in each group, with the intercept and slopes estimated as growth factors (latent variables in $\boldsymbol{\eta}i$). In the $\boldsymbol{\Lambda}$ matrix the intercept was fixed at 1 and the slopes were based on a common origination point of 0 at age 14. These fixed design elements were required to estimate the growth factors. The models were estimated in M*plus* using maximum likelihood estimation (Muthén & Muthén, 1998-2010). Using M*plus* software for latent growth modeling provided parameter estimates, standard errors, *p*-values, and measures of model goodness-of-fit statistics (χ^2, AIC, BIC, and RMESA; Muthén & Muthén, 1998-2010).

Missing data. Each age cohort represented a different pattern of "missingness" (S.C. Duncan et al., 1996). For example, participants in the age 16 cohort may have had information for some or all of the following time points 2, 2.5, 3, 3.5, and 4, which corresponded to the ages 16, 16.5, 17, 17.5, and 18. This resulted in missing data for this cohort between the time points 0 to 2 and 4 to 5.5 (Table 3.7; Anderson, 1993; S.C. Duncan et al., 2006). Because this "missing" data was purposefully not collected, it could be considered missing completely at random (MCAR). However, the M*plus* software handled the data that was missing by design, as well as any other missing data, under the assumption that the data were missing at random and using a maximum likelihood estimation (Muthén & Muthén, 1998-2010; S.C. Duncan et al., 2006).

Model evaluation and selection. As stated by Bozdogan (1987), "The main purpose of model evaluation is to 'understand' the observed data" (p. 346). Described previously, three initial unconditional models were chosen based on both theoretical plausibility and statistical evidence. It was theoretically plausible that stress management skills scores might be best represented by no-change, linear change, or accelerating/ decelerating change (quadratic) models in a sample of participants from a population of adolescent girls engaged in high risk sexual behaviors. Findings from aim 2 provided statistical support for the quadratic change model, and, to a lesser extent, the linear change model. It is important to use both theory and statistics when evaluating potential models of change as one may find a statistical model that fits the data perfectly, but the same model may not make sense theoretically (Cudeck & Browne, 1983; Henly, Vermeersch, & Duckett, 1998). Using both theory and statistical evidence, each model was evaluated in order to select the model that both best represented the data and made theoretical sense.

Theoretical plausibility. Theoretically, stress management skills increase during adolescence (Bar-On, 2006; Goleman, 2001; Matthews, Roberts, & Zeidner, 2003; Mayer, Salovey, & Caruso, 2008). However, evidence regarding when and how stress management skills increase are lacking (Schutte, Malouff, Thorsteinsson, Bhullar, & Rooke, 2007; Zeidner, Matthews, Roberts, & MacCann, 2003). Based on knowledge regarding adolescent cognitive development, it seemed plausible that adolescents have a steady increase in stress management skills over time. On the other hand, it was also plausible that there may be times during adolescence when stress management skills, like other areas of growth, change at different rates over time, making the quadratic model of growth plausible. In addition, given what is known about how individuals react to stress, relevant to the current study given the persistently high levels of environmental stress to which girls in this study sample were exposed, it was also possible that individuals could have stress management skills that decreased over time perhaps because stressors overwhelmed the girls' stress management skills, in either a linear or quadratic fashion (Secor-Turner, Garwick, Sieving, & Seppelt, 2011). Finally, no growth in stress management skills over time was plausible, due to the volume of stressors among this group of girls countering normal development of these skills (Secor-Turner et al.).

Statistical fit. As previously mentioned, four test statisitics and model selection criteria were used to assess model fit of the three unconditional models. Goodness-of-fit indices can be used to compare nested latent growth models, and have the important property that the use of additional parameters does not create worse fit (Cudeck & Browne, 1983). This means that models can be compared, beginning with the simplest model and adding parameters, and the fit will increase to the point of model saturation (where additional parameters do not help explain any further variation in the model). According to Cudeck and Browne , this strategy of examining multiple models is important in determining which model "best approximates reality" (p. 150). There is no single goodness-of-fit index that can identify the "correct" model of growth. Therefore, by using information from multiple indices, it is more likely that a best model fitting the data from the current sample of participants will be chosen (Li et al., 2000). Ultimately, the researcher uses selection criteria to compare the models and assesses goodness-of-fit of the selected model. In addition, theory is used to interpret parameters in the selected model.

The χ^2 statistic test gives both a χ^2 value and a probability level (*p*-value). Small χ^2 values are desired; however, it is the probability level in connection with a small value that actually indicates that the model is a good fit (Anderson & Gerbing, 1984).

Bozdogan (1987) cites Occam's razor to describe the importance of parsimony when choosing a model. The best model is one with the best fit to the data, while also having the least complexity. Two of the model selection criteria used in the current study were the Akaike information criteria (AIC) and Bayes information criteria (BIC). The Akaike information criterion (AIC) criterion can be used to compare models and into account the complexity of the model. As parameters are added to a model, this criterion will increase in value, indicating poorer model fit. The AIC criterion is defined in Table 3.6. The Bayes information criterion (BIC) was also used. The BIC is similar to the AIC, but the BIC gives even more weight to simpler models (Forster, 2000).The BIC is defined in Table 3.6.

Another fit measure used in the current study is the root mean square error of approximation (RMSEA), illustrated in Table 3.6. While most model fit indices are based on the number of free model parameters the RMSEA can be used as a measure of "discrepancy per degree of freedom" and as a measure of approximate fit of the in the population the RMSEA is concerned with discrepancy due to this approximation (Jöreskog, 1993, p. 310). This means that instead of using a null hypothesis of exact fit, which is tested by most model fit indices, the RMSEA utilizes a null hypothesis of close fit (Preacher, Cai, & MacCullum, 2007; Schermelleh-Engel, Moosbrugger, & Müller, 2003). Thus, the RMSEA tests for a small difference when comparing models (Preacher et al.).

Table 3.6

Model Testing Criteria

Model Testing Criteria	Equation
Akaike Information Criteria (AIC)	$-2\log L + 2k^{a}$
Bayes Information Criteria (BIC)	$-2\log L + k\ln(n)$
Root Mean Square Error of Approximation (RMSEA)	$\varepsilon = \sqrt{(\lambda/[d(n - 1)])}^{b}$

[a]*k* is the number of free parameters in the AIC model (Bozdogan, 1987). [b]λ is a noncentrality parameter with $\lambda > 0$, *d* is degrees of freedom and in a given sample (λ-hat)= $\chi^2 - d$ (Browne & Cudeck, 1993; Hancock & Freeman, 2001).

Aim 4. According to Li et al. (2000), growth curve analysis can be thought of as two stages. The first stage, which involves finding the most appropriate model of change to fit the data, was accomplished in aim 3. In the second stage covariates can be added to help explain variation in individual growth parameters over time (T.E. Duncan & S.C. Duncan, 2004; Li et al., 2000). Aim 4 is a preliminary attempt to use indicators of social connectedness and sexual behavior at the first survey occasion to predict initial level of stress management skills and functional form of change in stress management skills over time. This objective is tentative in nature due to the use of predictors collected across multiple ages to predict an intercept, or initial level of stress management skills, at age 14.

Incorporation of covariates into the latent growth model. Four covariates (school connectedness, family connectedness, number of male sex partners in the past six months, and partner communication regarding sexual risk) were chosen for their potential relationships to growth trajectories of stress management skills among this group of adolescent girls. Effects of the covariates were tested on both the intercept and the slope (Figure 3.8). The equations were defined for intercept and slope and were based on work from Li et al. (2000):

$$\boldsymbol{\eta}_i = \boldsymbol{\alpha} + \boldsymbol{\Gamma}\mathbf{x}_i + \boldsymbol{\zeta}_i \quad (3)$$

where $\mathbf{x}_i$ is the matrix of covariates, and x_1 represents number of male sex partners in the past 6 months, x_2 represents partner communication regarding sexual risk, x_3 represents family connectedness, and x_4 represents school connectedness. $\boldsymbol{\eta}_i$ is a 2 x 1 vector which contains the individual growth factors for individual *i*, including the intercept ($\boldsymbol{\eta}_{0i}$) and slope ($\boldsymbol{\eta}_{si}$). $\boldsymbol{\alpha}$ is a 2 x 1 vector containing the mean linear latent growth factors for the intercept and slope (μ_0, μ_s). The $\boldsymbol{\Gamma}$ matrix is 2 x 4 and contains the coefficients for the regression of $\boldsymbol{\eta}_i$ on $\mathbf{x}_i$. These coefficients are represented for the regression of the intercept on each covariate (γ_{11}, γ_{12}, γ_{13}, γ_{14}) and the slope on each covariate (γ_{21}, γ_{22}, γ_{23}, γ_{24}). The covariates vary across individuals, which was indicated with the subscript *i* on **x**. $\boldsymbol{\zeta}_i$ represents the deviation of the individual's growth parameters from means in the $\boldsymbol{\alpha}$ matrix controlling for the covariates. This is called a conditional growth model because both the initial level of stress management skills and the change in stress management skills over time are being modeled as a function of the covariates (Li et al., 2000).

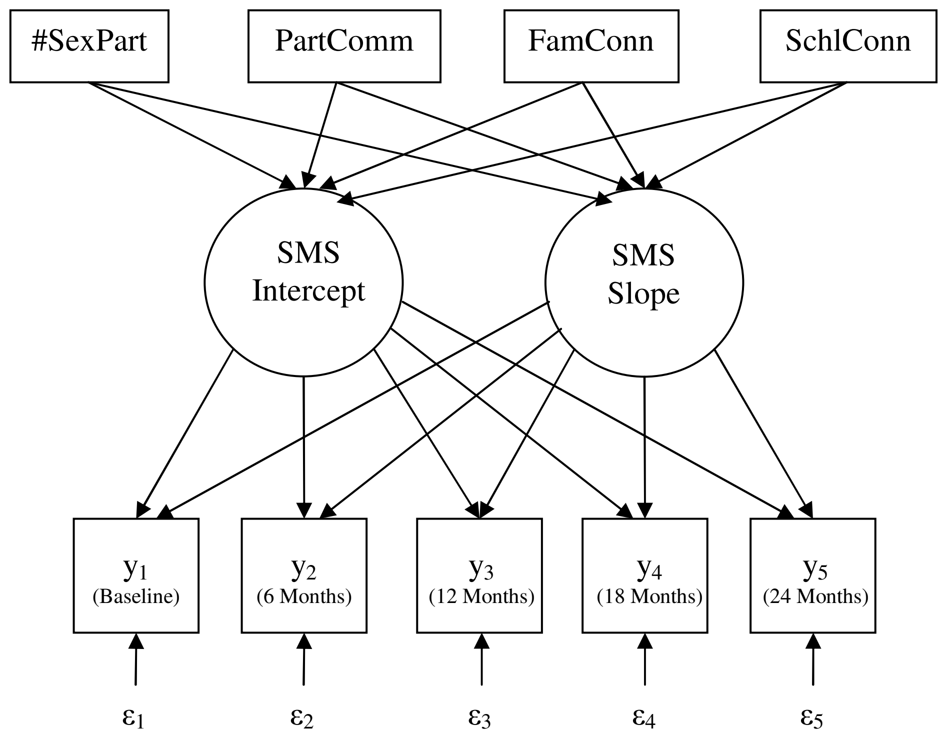

Figure 3.9. Overall linear path model incorporating covariates measured at the initial survey to predict stress management skills over five time points. #SexPart = number of sex partners in the six months prior to baseline; PartComm = partner communication regarding sexual risk; FamConn = family connectedness; SchlConn = school connectedness; SMS = stress management skills.

Modeling plan.

Selecting covariates. Backwards deletion of covariates was used in the latent growth model analyses to determine the most parsimonious model. Backwards deletion allows all predictors to initially be placed into the model and then variables that do not significantly add to the model (at a level of significance $p < .05$) are deleted and the model is tested again. This type of deletion reduces problems with multi-collinearity while simultaneously avoiding the deletion of covariates that may be helpful in explaining the model (S.C. Duncan et al., 2006).

Model evaluation and selection. Model evaluation and selection proceeded based on theoretical plausibility and statistical significance of proposed predictor variables.

Theoretical plausibility: Relationship between covariates and stress management skills trajectory. It is proposed that variation in adolescent girls' levels and trajectories of stress management skills could be at least partially explained through the use of social connectedness and sexual behavior indicators. The four covariates, representing social connectedness and sexual behaviors, were chosen based on the theoretical possibility that they were related to both initial levels stress management skills and change in stress management skills over time. The theoretical and empirical reasoning behind these proposed relationships were described in Chapter 2.

Statistical significance of covariates. All covariates were added to the model chosen in aim 3 and backwards deletion was used to determine which covariates helped explain change over time, as described above. The statistical significance of covariates was determined by examining the *p*-value connected with the parameter estimates for intercept, slope, and/or the quadratic term. The final model included only significant covariates. Overall fit statistics were reported for both the initial model (including all covariates) and the final model.

Chapter IV: Results

This chapter will present the results of the analyses conducted to address study aims. The overall goal of the current study was to examine stress management skills over time in adolescent girls engaged in high-risk sexual behaviors, determine if growth occurred in these skills over time, and if so, what type of growth. This study also aimed to determine if the same model of growth could be used over all of the adolescent ages represented in the study sample through the use of an accelerated cohort design. If growth occurred across the ages of 14 to 19, a tentative aim of this study was to determine the impact of theoretically relevant covariates measured at the initial occasion of measurement on initial levels of stress management skills at age 14 and on change in stress management skills between the ages of 14 to 19.

The specific aims of this study were to:

1. Describe baseline (the first survey occasion for each participant) stress management skills and study predictors (family connectedness, school connectedness, partner communication regarding sexual risk, and number of male sex partners in the past six months) and relationships among these variables.
2. Describe stress management skills at five time points over 24 months, exploring initial level of stress management skills and functional form of change in both individuals and age cohorts over time.
3. Using data from an accelerated cohort design, model normative change in stress management skills linking growth curve segments from each age cohort (from ages 14 to 19 years).

4. Use indicators of social connectedness and sexual behavior at the first survey occasion to predict initial level of stress management skills and functional form of change in stress management skills over time.

This chapter begins by presenting within-period descriptive statistics and associations to address study aim 1. An exploratory analysis of the initial level of stress management skills and form of change in stress management skills over the five time points is presented to address study aim 2. Findings from growth curve trajectory models that link data from four age cohorts and describe the development of stress management skills over time are presented, addressing study aim 3. Finally, findings from an analysis linking covariate predictors of social connectedness and sexual behavior with stress management skills trajectories are presented (aim 4).

Aim 1: Description of Baseline Variables

The objective of aim 1 was to provide information about each of the variables in the current study at the first occasion of measurement (called baseline for the current study, although the age of participants at baseline varies by cohort), through descriptive statistics and examination of relationships among the variables. Information on each of these variables by age cohort is presented in Appendix B.

Social connectedness indicators. In this sample of adolescent girls, perceptions of social connectedness were moderate. Participants reported moderately high connections with their schools, and slightly lower levels of connections with family members at baseline (Table 4.1).

Table 4.1

Baseline Variables (Total Sample, N = 125)

Variable/Indicator	**Mean**	**Standard Deviation**	**Observed Range of Scores**
School Connectedness	3.10	0.52	1.89 – 4.00
Family Connectedness	2.80	0.90	1.00 – 4.00
Partner Communication Re: Sexual Risk	2.12	0.54	1.00 – 3.00
Number of Sex Partners in Past Six Months	1.77	1.27	1.00 – 7.00
Stress Management Skills	2.51	0.72	1.00 – 3.83

Sexual behavior indicators. On average, participants reported discussing sexual risk with their most recent male partner after they first had sex (Table 4.1). Girls in this study reported an average of about two male sex partners during the 6 months prior to the baseline survey, with a mean of 1.77 (Table 4.1).

Stress management skills. On average, girls reported a moderate level of stress management skills at baseline (Table 4.1). This indicates that, on average, girls reported engaging in negative behaviors (e.g., “I fight with people”) and having negative feelings (e.g., “I get upset easily”) between “sometimes” and “often”.

Associations between baseline variables. Correlations among the baseline predictors and stress management skills are shown in Table 4.2 (correlations by cohort are shown in Appendix C). School connectedness had a strong positive relationship with stress management skills at baseline ($r = .41$, $p < .001$). This relationship indicates that as school connectedness increased stress management skills also increased. A significant relationship existed between the second social connectedness indicator, family connectedness, and stress management skills as well ($r = .33$, $p < .001$). The positive correlation between stress management skills and family connectedness indicated that girls with high levels of stress management skills also reported being highly connected to their families.

Neither indicator of sexual behavior was significantly correlated with stress management skills at baseline.

Table 4.2

Correlations Among Baseline Predictors and Stress Management Skills

Variable/Indicator	School Connectedness	Family Connectedness	Partner Communication	Number of Sex Partners[a]	Stress Management Skills
School Connectedness	–	.49**	.17	-.29[a]**	.41**
Family Connectedness		–	.20*	-.25[a]**	.33**
Partner Communication			–	-.18[a]*	.10
Number of Sex Partners[a]				–	-.17[a]
Stress Management Skills					–

[a]Spearman's ρ non-parametric correlation

*$p < .05$ **$p < .01$

Aim 2: Stress Management Skills Change Over Time

The first objective of aim 2 was to describe stress management skills over each of the study time points and across age cohorts, as well as to examine auto-correlations of this measure over time. The second objective of aim 2 was to use an initial data analysis to describe individual and group change in stress management skills over time. The purpose of the initial data analysis was to guide a decision about the models of change to test using the accelerated cohort design (aim 3). The age 13 cohort contained only three participants, therefore, this cohort was removed from descriptive statistics and correlations related to aim 2.

Description of stress management skills across survey time points. Means and standard deviations for stress management skills in each age cohort are presented in Table 4.3. This table also shows the weighted means across cohorts contributing to each age. On average, the weighted means show that this sample of girls reported a moderate amount of stress management skills, with small increases and decreases across the years from age 14 to age 19.

Within age cohorts, the lowest mean for all time points and cohorts occurred among the age 15 cohort at the first measurement occasion (*Baseline M* = 2.36, *SD* = 0.72). The highest mean across time points and cohorts was for the age 14 cohort, at both 18 and 24 months (ages 15.5 and 16 years), where this cohort had means close to 3 (*18 Month M* = 2.99, *SD* = 0.64; *24 Month M* = 2.99, *SD* = 0.56). A mean score close to 3 indicates that, on average, participants reported only occasionally engaging in negative behaviors or having negative feelings that correspond to poor stress management skills.

Table 4.3

Means (Standard Deviations) of Stress Management Skills Within Age Cohorts and Weighted Means Across Age Cohorts

		Age										
Age Cohort	***N***	**14**	**14.5**	**15**	**15.5**	**16**	**16.5**	**17**	**17.5**	**18**	**18.5**	**19**
14	27	2.73 (0.72)	2.75 (0.71)	2.79 (0.62)	2.99 (0.64)	2.99 (0.56)	–	–	–	–	–	–
15	30	–	–	2.36 (0.65)	2.37 (0.80)	2.51 (0.77)	2.51 (0.79)	2.76 (0.75)	–	–	–	–
16	35	–	–	–	–	2.52 (0.67)	2.74 (0.66)	2.72 (0.65)	2.74 (0.60)	2.70 (0.67)	–	–
17	30	–	–	–	–	–	–	2.59 (0.75)	2.73 (0.63)	2.70 (0.71)	2.69 (0.75)	2.74 (0.76)
Weighted Mean	122	2.73 (0.72)	2.75 (0.71)	2.56 (0.67)	2.67 (0.78)	2.65 (0.70)	2.63 (0.73)	2.69 (0.71)	2.73 (0.61)	2.70 (0.68)	2.69 (0.75)	2.74 (0.76)

Stress management skills over five time points. Stress management skills had strong auto-correlations across the study's five time points in the full sample (Table 4.4). All correlations were significant at $p < .01$ and ranged from a low of $r = .41$ between the baseline and 24 month surveys and a high of $r = .64$ between the 12 and 18 month surveys. However, given the large number of correlations tested from the full sample and in each individual cohort, it is difficult to interpret the significant *p*-value, and these correlations may be nominal at best. In this case, the patterns of correlations may provide more information than the significance level of the correlations.

Across cohorts and occasions, all correlations were positive (Tables 4.5 – 4.8). This means that greater stress management skills at one time point corresponded to greater stress management skills at other time points. Most correlations were also significant, although as mentioned previously, this may not be a meaningful test given the number of correlations tested. In general, correlations that occurred closer in time were larger. For example, in the age 14 cohort the correlation between 6 months and 12 months was larger than the correlation between baseline and 12 months. Magnitude of correlations were fairly similar across age cohorts, with the biggest exception occurring in the age 16 cohort, which had correlations of smaller magnitude than other cohorts and more non-significant values than any of the other cohorts (Table 4.7).

Table 4.4

Correlations among Stress Management Skills Over Five Time Points for the Full Sample

Occasion of Measurement	Baseline	6 Months	12 Months	18 Months	24 Months
Baseline	–	.56**	.59**	.42**	.41**
6 Months		–	.58**	.53**	.45**
12 Months			–	.64**	.58**
18 Months				–	.63**
24 Months					–

** $p < .01$ (2-tailed)

Table 4.5
Correlations among Stress Management Skills Over Five Time Points for Age 14 Cohort

Occasion of Measurement	Baseline	6 Months	12 Months	18 Months	24 Months
Baseline	–	.52**	.53**	.28	.48*
6 Months		–	.72**	.54**	.63**
12 Months			–	.58**	.59**
18 Months				–	.67**
24 Months					–

*$p < .05$ ** $p < .01$ (2-tailed)

Table 4.6

Correlations among Stress Management Skills Over Five Time Points for Age 15 Cohort

Occasion of Measurement	Baseline	6 Months	12 Months	18 Months	24 Months
Baseline	–	.55**	.72**	.56**	.67**
6 Months		–	.62**	.68**	.61**
12 Months			–	.63**	.55**
18 Months				–	.64**
24 Months					–

** $p < .01$ (2-tailed)

Table 4.7

Correlations among Stress Management Skills Over Five Time Points for Age 16 Cohort

Occasion of Measurement	Baseline	6 Months	12 Months	18 Months	24 Months
Baseline	–	.45*	.44**	.32	.34
6 Months		–	.34	.26	.30
12 Months			–	.71**	.71**
18 Months				–	.67**
24 Months					–

**p* < .05 ** *p* < .01 (2-tailed)

Table 4.8

Correlations among Stress Management Skills Over Five Time Points for Age 17 Cohort

Occasion of Measurement	Baseline	6 Months	12 Months	18 Months	24 Months
Baseline	–	.66**	.62**	.39*	.20
6 Months		–	.59**	.52**	.31
12 Months			–	.62**	.49**
18 Months				–	.56**
24 Months					–

**p* < .05 ** *p* < .01 (2-tailed)

Initial data analysis.

Individual change. Individual scatter plots were created for each participant. First, non-parametric empirical trajectories were fitted to individual data by linking data points with a smoothed curve. All regressions were centered on age 14, in order to create a common origin across cohorts and to be consistent with the analyses to be conducted in aim 3. Examples of individual non-parametric trajectories are shown in Figure 4.1. Next, ordinary least squares (OLS) regression was used to create both linear and quadratic trajectories. Then, linear and quadratic trajectories were separately superimposed on empirical scatter plots of each participant (Figures 4.2 and 4.3). This analysis allowed for a visual inspection of how well these fitted trajectories approximated the individual's reported levels of stress management skills over time.

The samples of graphs shown in Figures 4.1 – 4.3 were chosen to show the variety of change exhibited by participants across cohorts. The same participants are shown in each figure, allowing for visual comparison of the empirical nonparametric plot and the fit of both linear and quadratic regression models to an individual's data. These graphs make it clear that girls began this study with different levels of stress management skills and changed differently over time. Some girls show little or no linear growth over time (e.g., Figure 4.1., Age 17_400050). This may indicate that a no-growth model would best fit these girls. Some girls changed in a linear fashion, which can be seen in the samples of graphs (e.g., Figure 4.1, Age 16_500042). Participants' quadratic graphs followed a variety of paths, convex (e.g., Age 15_700054), concave (e.g., Age 17_400024), as well as models that looked almost linear (e.g., Age 17_500015). As with the linear models, some participants changed in ways that fit a quadratic model very well, while others changed in ways that did not fit a quadratic model.

After examining individual participants' graphs, the goodness-of-fit of the exploratory linear and quadratic models were assessed. Goodness-of-fit was assessed by examining the R^2 and residual variance statistics for each participant. A stem-and-leaf plot of the R^2 values, comparing the linear and quadratic models is shown in Figure 4.1. The R^2 stem-and-leaf plot showed the modal value for the linear change model falling between .0 and .1, indicating that the linear model for change did not account for intra-individual variability for many of the girls in this sample. The quadratic model showed a much different pattern in the stem-and-leaf plot, with the modal value falling between .7 and .8. This indicates that adding a quadratic term to the original linear model may better explain intra-individual variability in change in stress management skills over time.

Linear	R^2	**Quadratic**
	1.0	0000
3	0.9	11123345667888
9542200	0.8	01112233445556778
8776665533333200	0.7	0134566777778888899
76663110	0.6	123566778999
954422110	0.5	02223444569
99987666500	0.4	01111456779
97554210	0.3	006678
932110000	0.2	11347
888654322000	0.1	000112245789
9999888776666554444332221111111000000000000	0.0	001124557889

Figure 4.1. Stem-and-leaf plot of R^2 statistics comparing goodness-of-fit between linear and quadratic models (N = 123).

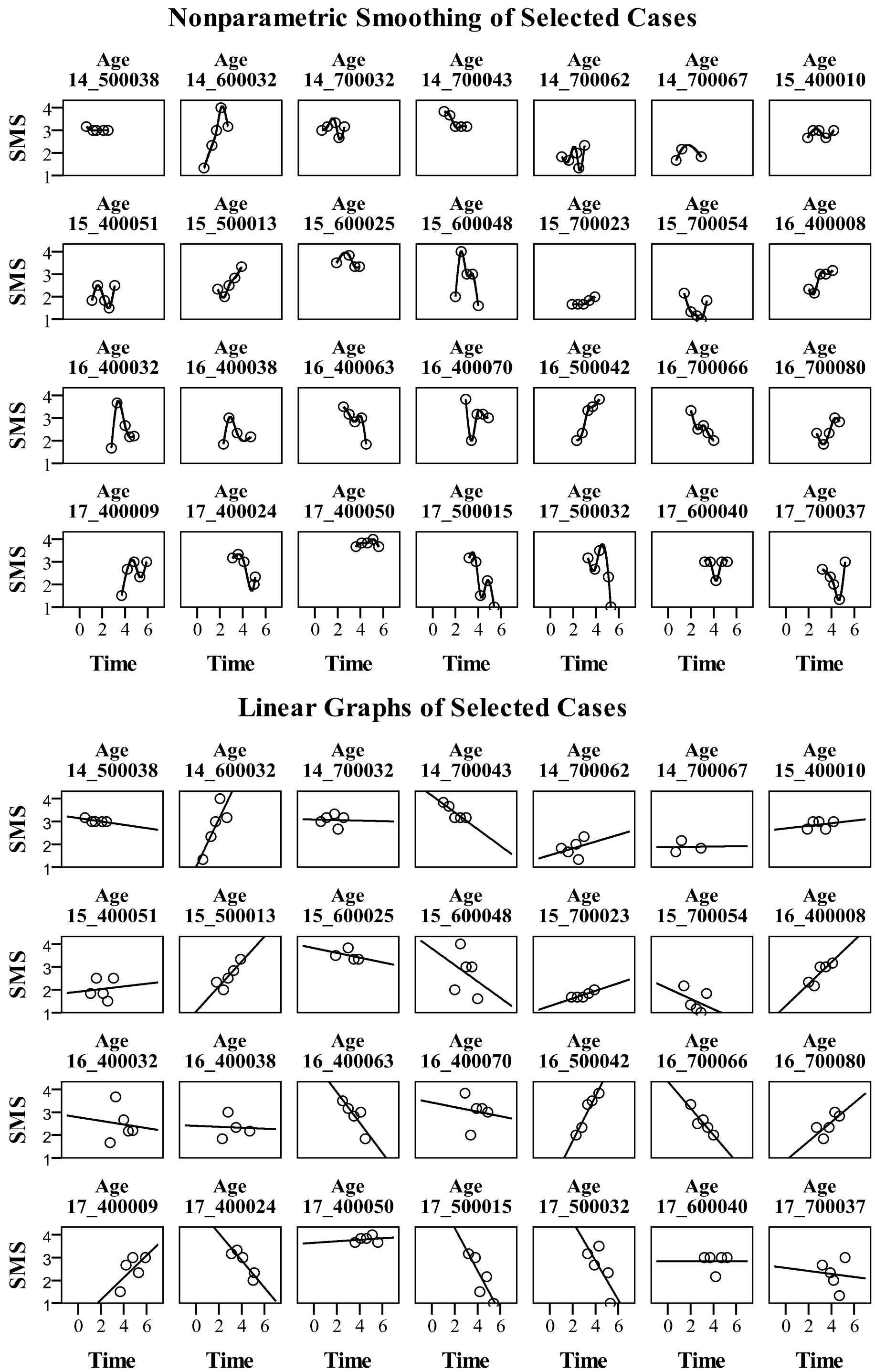

Figure 4.2. Individual nonparametric and linear graphs of stress management skills in each age cohort and across five time points. Time = Age – 14; SMS = Stress Management Skills

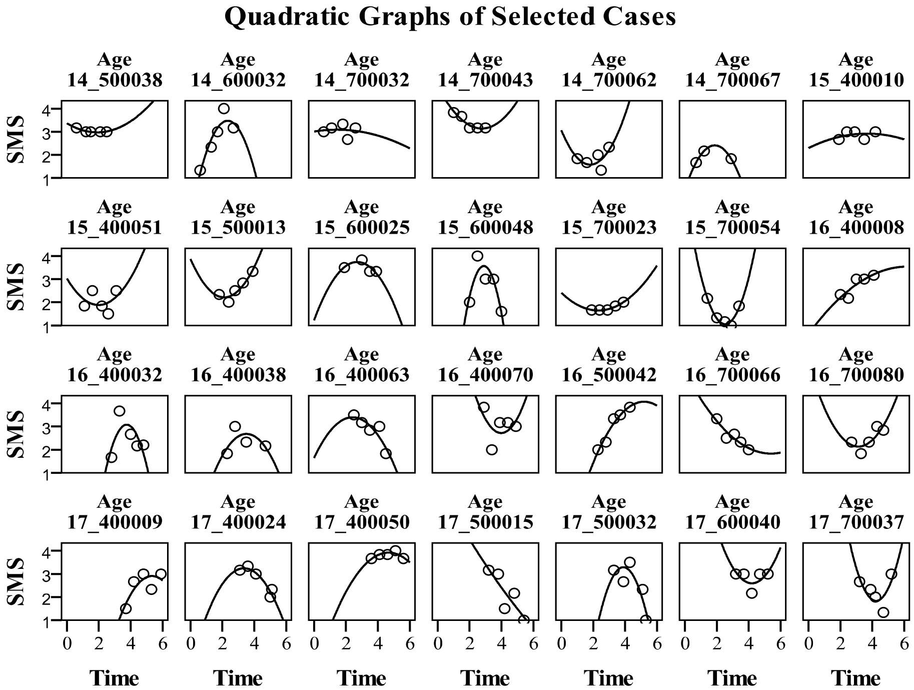

Figure 4.3. Individual quadratic graphs of stress management skills in each age cohort and across five time points. Time = Age – 14; SMS = Stress Management Skills.

Group change. Examining change within each age cohort indicates the individual nature of change and the appearance of average change within each cohort. Initial status and rate of change were calculated by fitting separate within-person ordinary least squares (OLS) regression models for stress management skills as a function of linear time. Seen in Table 4.9, the analysis revealed varying intercepts and slopes across age cohorts, with some cohorts showing a faster rate of change than others. However, even in the cohort with the fastest average rate of change (age 15 cohort slope = .19), had a relatively small amount of change per year which may not be statistically different than the cohort with the slowest average rate of change (age 16 cohort slope = .07).

Table 4.9

Parameters for Separate Within-Person OLS Regression Models for Stress Management Skills (No-Change, Linear, and Quadratic Models)

			Age Cohort				
Model		**Individual OLS Estimates**	**14** (n = 27)	**15** (n = 29[a])	**16** (n = 34[a])	**17** (n = 30)	**All** (n = 120[a])
No Change	b_0	Mean	2.85	2.50	2.68	2.69	2.68
Linear	b_0	Mean	2.62	1.99	2.46	2.28	2.20
		SD	0.81	0.92	1.35	2.21	1.76
	b_1	Mean	0.14	0.19	0.07	0.08	0.13
		SD	0.32	0.27	0.38	0.48	0.37
		Correlation b_0, b_1	-.72**	-.72**	-.93**	-.97**	-.91**
Quadratic	b_0	Mean	2.91	2.33	0.90	2.22	2.03
		SD	1.47	3.51	5.74	8.92	5.70
	b_1	Mean	-0.19	-0.12	1.06	0.03	0.24
		SD	1.73	2.81	3.19	4.34	3.19
	b_2	Mean	0.08	0.07	-0.15	0.01	-0.004
		SD	0.47	0.52	0.43	0.52	0.49
		Correlation b_0, b_1	-.89**	-.98**	-.99**	-.99**	-.96**
		Correlation b_0, b_2	.83**	.96**	.96**	.96**	.85**
		Correlation b_1, b_2	-.98**	-.99**	-.99**	-.99**	-.96**

[a]Information from two participants could not be used, because they only reported stress management skills on one occasion.

**p < .01

No-change and quadratic OLS models are also shown in Table 4.9, graphs of these models are shown in Figure 4.4 through 4.6.

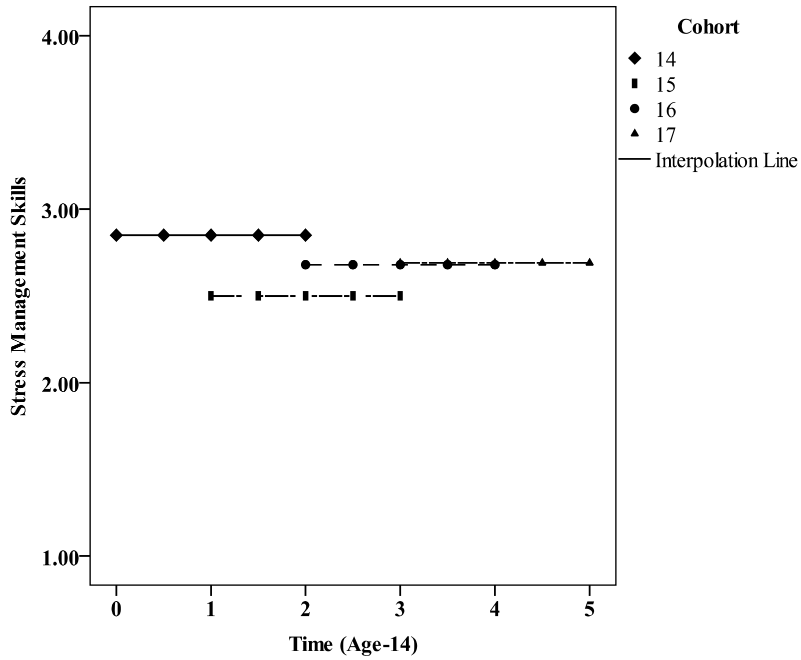

Figure 4.4. OLS regression by cohort for no-change model.

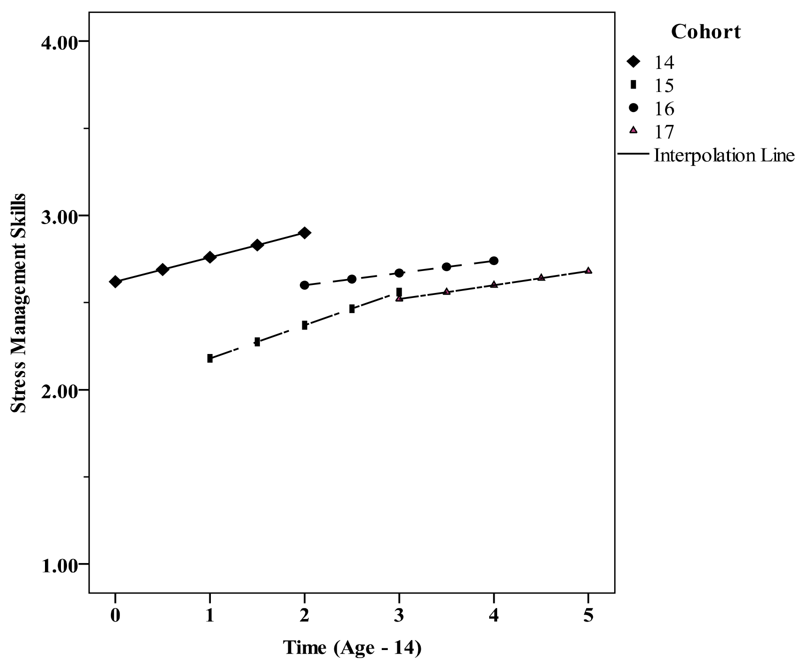

Figure 4.5. OLS regression by cohort for linear model.

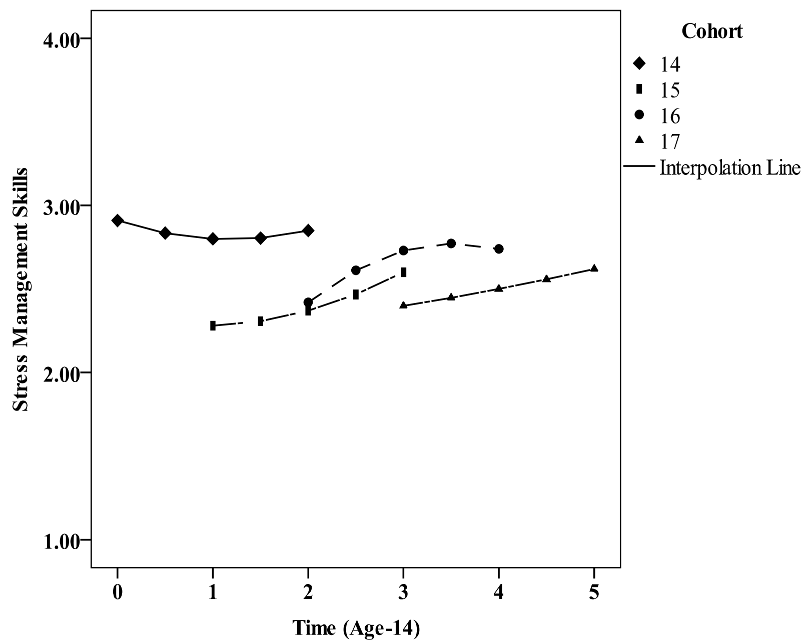

Figure 4.6. OLS regression by cohort for quadratic model.

In the full sample, girls, on average, started the study with a moderate level of stress management skills, at 2.20 on a scale that had a maximum of 4.0. However, they varied greatly around this mean, as evidenced by the large standard deviation of 1.76. The intercepts were significantly correlated with the slopes (i.e., rates of change in stress management skills over time) at $p < .01$ in the full sample and in each age cohort. The intercept/slope correlations were all negative, suggesting that girls who had higher levels of stress management skills at the beginning of the study changed less over time (Bliese & Ployhart, 2002). The age 14 and age 15 cohorts each had correlations of $r = -.72$ between the fitted intercepts and slopes, and while relatively large negative correlations, the magnitude of these correlations were smaller than the correlations in the other cohorts and the total sample. The age 17 cohort had the largest correlation, with an almost 1:1

relationship between the fitted intercept and slope at $r = -.97$. This suggests that 17 year olds who began the study with high levels of stress management skills tended to increase very little over time. It is also possible that this large correlation represents a ceiling effect due to the measurement scale of stress management skills (Hedeker, 2004). If stress management skills increases over time, more of the participants who were age 17 at the beginning of the study would be expected to have had higher initial levels of stress management skills. If these participants began at the top of the stress management skills scale (i.e., with scores around 4.0), any additional gains in stress management skills would not have been detected by the EQi:YV scale. Thus, the only change that could have been detected would be a decrease in stress management skills, creating a potentially artificial correlation between higher scores and decreases in stress management skills over time. However, participants in the age 17 cohort began the study with an average level of stress management skills at 2.28, which made it unlikely that the majority of participants reached the ceiling of 4.00, when stress management skills only change at a rate of 0.08 per year. In addition, the linear cohort graph for the age 17 cohort (Figure 4.7) shows girls who began with the highest levels of stress management skills decreased rapidly over time, further supporting the finding that girls who began with high levels of stress management skills increased less over time than girls who began with lower levels of these skills.

Visual evidence from the individual linear and quadratic growth trajectories in Figures 4.2 and 4.3 suggested that there were many different patterns of change across this sample of girls. This evidence is reinforced by the linear and quadratic group graphs by age cohort, shown in Figures 4.5 and 4.6.

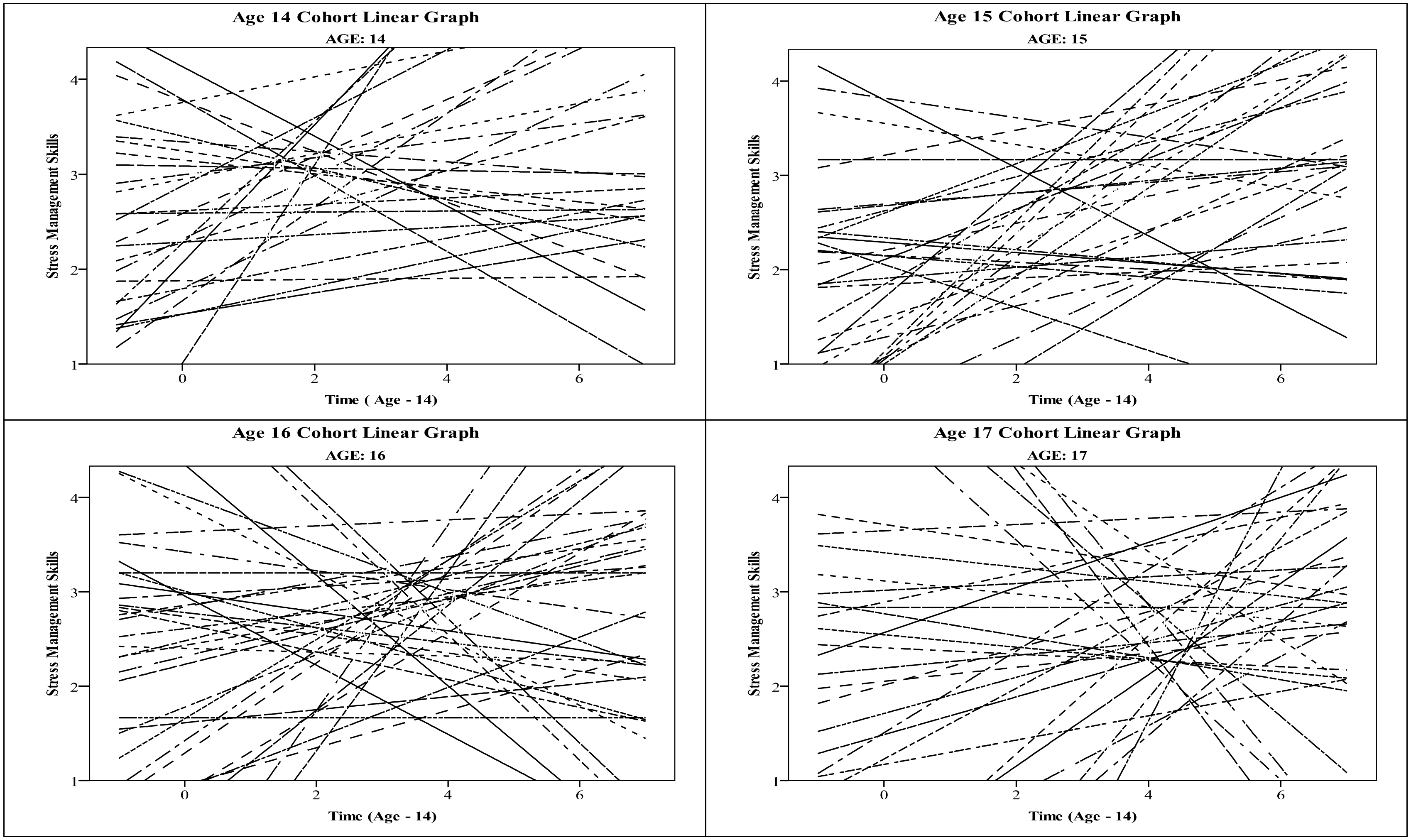

Figure 4.7 Linear graphs of stress management skills by cohort using OLS regression over five time points.

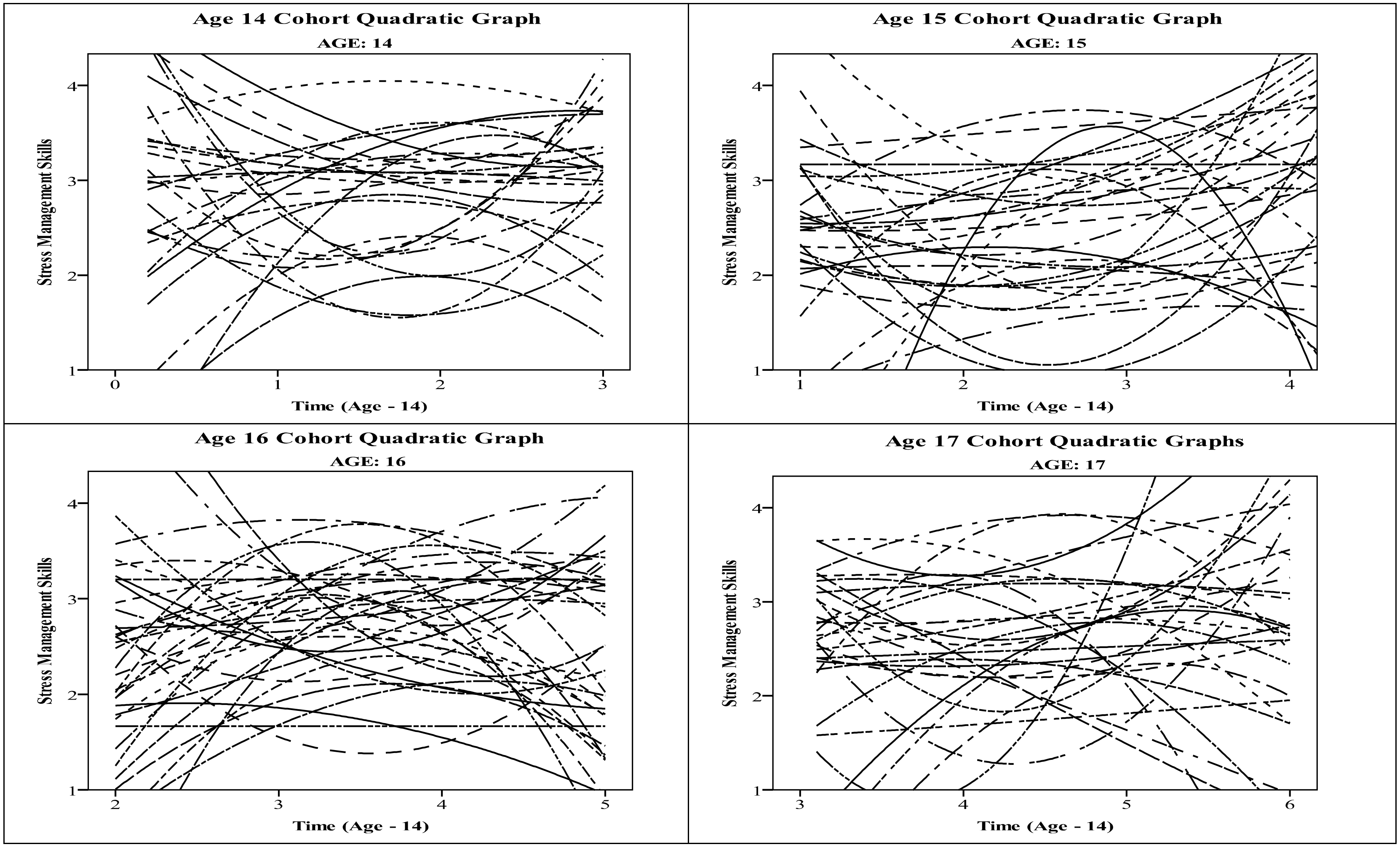

Figure 4.8. Quadratic graphs of stress management skills by cohort using OLS regression over five time points.

Modeling decision. Evidence from aim 2 analysis suggests that either linear or quadratic models may provide good fit for change in stress management skills in this sample of girls. An important consideration when choosing a model is complexity, with a more parsimonious model being desirable. In order to build complexity from the bottom up, beginning with the least complex model, a no-growth model was tested in addition to linear and quadratic models.

Aim 3: Linking Stress Management Skills Growth Curve Segments Using Accelerated Cohort Analysis

The objective of aim 3 was to model change in stress management skills over time using an accelerated cohort approach. The first step was to examine visually whether it appeared that the girls in this sample came from the same underlying population. The next step was to determine empirically if using an accelerated cohort design fit the data from this sample. Convergence across cohorts was determined for each type of growth model (no-growth, linear, and quadratic; Anderson, 1993; Orth et al., 2010). Specifically, by comparing constrained models of growth (residual variances were constrained in these models) with freely varying models (residual variances were not constrained) it was possible to determine whether girls from each age cohort changed in the same way on stress management skills over time. If the constrained model fit the data this indicated that the girls came from the same underlying statistically significant population and that a model could be built using data from separate growth curve segments to link stress management skills across cohorts and across time (Anderson; Orth et al.). If the accelerated cohort model converged, a final step was to compare different models of change (no-growth, linear, and quadratic) to determine which type of model best describes change over time.

Accelerated cohort model. The accelerated cohort data were first examined visually using by studying the OLS regression curves, means from each cohort over time and weighted means over time to create initial growth trajectories prior to statistically testing for convergence. The OLS growth trajectories of no-change, linear, and quadratic change from the initial data analysis were the first to be examined (Figures 4 – 6). Each of these graphs provided preliminary evidence for overlap among the cohorts. The no-change trajectory (Figure 4.4) showed three points of overlap between the age 16 and 17 cohorts. In the linear graph (Figure 4.5) the last point for the age 15 cohort came close to overlapping with the age 17 cohort, while the age 16 cohort appeared to follow the other trajectories closely. The quadratic OLS graph (Figure 4.6) appeared to be somewhat similar to the linear OLS graph, although the age 15 and 16 cohorts are the curves that now display a point close to overlap. In this graph, the age 17 cohort curve still remains close to the age 15 and 16 curves. In all of the OLS graphs, the age 14 cohort appears to have a slightly different trajectory of regression. In the no-change graph, which is a constant line of the intercept for each age cohort, the age 14 cohort begins with a higher level of stress management skills. However, in the linear OLS graph, the age 14 cohort appears to start at about the same level as the age 16 cohort, but appears to increase at a greater rate and ends with a higher level of stress management skills than the other cohorts. Interestingly, in the quadratic OLS regression, the age 14 cohort once again begins with a higher level of stress management skills, but decreases appears to decrease slightly over time with a small increase at the final time point. These observations based on the initial data analysis will need to be considered when modeling the accelerated cohort design. If a common curve does not fit across the cohorts, it will be possible that removing the age 14 cohort will all the data to fit into a constrained curve.

The examination of the observed data, including means from each cohort and weighted means over time revealed differences in the means and standard deviations across cohorts for overlapping time points, as seen in Table 4.3 and Figure 4.9. As depicted in Figure 4.9, the trajectories for each cohort looked somewhat different than the trajectory created by weighted means.

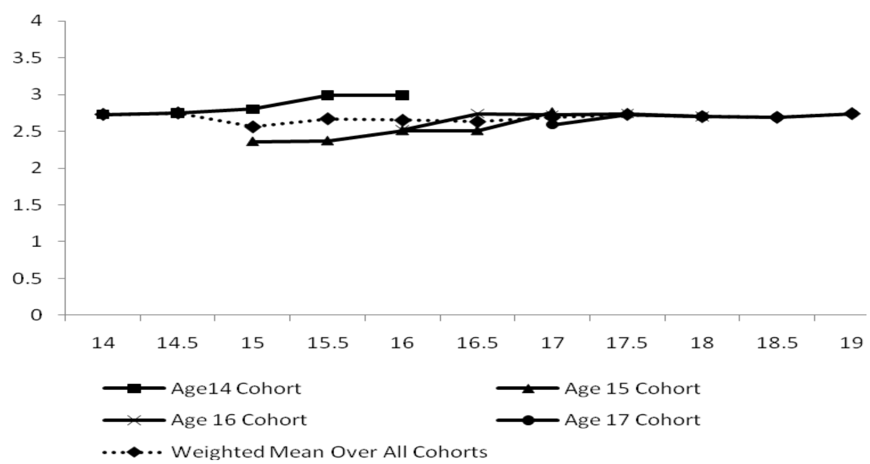

Figure 4.9. Trajectories of average change of stress management skills over time in each cohort and using weighted means across cohorts.

Testing for convergence. The next step was to directly test whether these cohorts converged by linking together the segments from each cohort using M*plus* (Muthén &

Muthén, 1998-2010). No-change, linear, and quadratic models were examined using fit statistics to determine if a constrained, or common, trajectory provided a better fit to the data than a cohort-specific trajectory. A constrained trajectory would provide evidence that an accelerated cohort design could be used to model data across cohorts. Fit statistics for a constrained, or common, trajectory and cohort-specific trajectory are displayed in Table 4.10 for no-change, linear and quadratic models. While findings were mixed, overall a constrained trajectory was a better fit to the data for no-change, linear and quadratic models. The χ^2 for the no-change cohort-specific model suggested this model fit the data better than the common constrained model, but other model fit statistics (AIC, BIC, RMSEA) indicated that the constrained trajectory was a better fit for the no-change model. While the χ^2 and RMSEA fit statistics favored the cohort-specific linear model, the AIC and BIC both indicated that the constrained linear model was a better fit to the data. In addition, the linear model had a non-positive definite result in the $\boldsymbol{\psi}$ matrix for the age 15 cohort. This result means that fit statistics cannot be interpreted for the age 15 cohort, making it impossible to determine whether the cohort-specific trajectory was a better fit to the data, assuming a linear model of change. For the quadratic cohort-specific model, each cohort had results that were non-positive definite, which meant that the model fit statistics for these trajectories could not be interpreted. The non-positive definite results could be related to the relatively small sample size per cohort, and the larger number of parameters that were required to estimate a cohort-specific quadratic model.

Both the linear and quadratic accelerated cohort models had RMSEA values that indicated good fit of the data. An RMSEA of .05 or lower generally represents acceptable fit, indicating that these versions of the accelerated cohort model provided an adequate fit to the data (Brown & Cudeck, 1993; S.C. Duncan et al., 2006; Preacher, Cai, & MacCallum, 2007). The decision to retain the constrained trajectory for each type of growth model indicates that there was convergence of this model across cohorts. This provides empirical evidence that the age cohorts of girls came from the same "true longitudinal population" (S.C.Duncan et al., 2006).

Table 4.10

Model Fit Statistics for Candidate Models (N = 123)

Model	Criterion	Trajectory: Common	Trajectory: Cohort Specific
No Change	χ^2 (*df, p*)	96.59 (*df* = 77, *p* = .06)	65.90 (*df* = 52, *p* = .09)
	AIC	1042.77	1062.08
	BIC	1051.18	1140.59
	RMSEA (probability ≤ 0.05)	.091 (.15)	.094 (.18)
Linear	χ^2 (*df, n*)	77.41 (*df* = 74, *p* = .37)	26.34 (*df* = 40, *p* = .95)[a]
	AIC	1029.59	1046.51[a]
	BIC	1046.41	1158.68[a]
	RMSEA (probability ≤ 0.05)	.039 (.55)	.000 (.98)[a]
Quadratic	χ^2 (*df, n*)	63.71 (*df* = 70, *p* = .69)	N/A[b]
	AIC	1023.89	N/A[b]
	BIC	1051.92	N/A[b]
	RMSEA (probability ≤ 0.05)	0.000 (.82)	N/A[b]

[a]Cohort-specific linear model was not positive definite in the latent variable covariance matrix (**ψ**) in age 15 cohort; [b]Cohort-specific quadratic model could not be interpreted due to non-positive definite residual covariance matrix (**θ**) in age 14 cohort and non-positive definite latent variable covariance matrices (**ψ**) for the age 15 – 17 cohorts.

Model Evaluation and Selection. After determining that the common (constrained) curve provided a better fit to the data for each model than the respective cohort-specific models, the three proposed models of change were compared to determine which type of growth best fit the data. Based on findings from the initial data analysis from aim 2, as explained in Chapter 3, three forms of change were modeled, tested, and compared with one another to find the form that best fit the data. Models were compared based on model fit statistics including χ^2, AIC, BIC, and RMSEA (Table 4.10). The parameters for each model were also examined (Table 4.11).

Model 1: No change in stress management skills. The first model tested was the no-growth model, which contained intercepts only. This model did not provide a good fit to the data with non-significant χ^2 and RMSEA tests (χ^2 = 96.59, *df* = 77, *N* = 123, *p* = .06; *RMSEA* = .091). The AIC and BIC were slightly greater than the linear model, providing further evidence of the poor fit of this model.

Model 2: Linear change in stress management skills. The linear model provided an adequate fit to the data, with significant RMSEA. All parameters of this model were also significant.

Model 3: Quadratic change in stress management skills. The quadratic model provided the best fit based on χ2, AIC, and RMSEA statistics. The BIC suggested that the quadratic model had a slightly poorer fit than the linear model. This model had a significant mean intercept, intercept variance, and residual variance, but the other parameters in the quadratic model were not significant.

Table 4.11

Parameter Estimates for Common Curve Candidate Models

Model	Parameter	Estimate	Standard Error	*p*-Value
Model 1: No-Change	Mean intercept (μ0)	2.67	0.05	.00
	Intercept variance	.26	.04	.00
	Residual variance	.23	.02	.00
Model 2: Linear	Mean intercept (μ0)	2.47	0.09	.00
	Mean slope (μ1)	0.08	0.03	.00
	Intercept variance	.53	.15	.00
	Slope variance	.03	.01	.01
	Intercept & slope correlation	-.09	.04	.02
	Residual variance	.20	.02	.00
Model 3: Quadratic	Mean intercept (μ0)	2.44	0.11	.00
	Mean slope (μ1)	0.13	0.08	.10
	Mean quadratic (μ2)	-0.01	0.02	.42
	Intercept variance	.32	.11	.01
	Slope variance	.09	.07	.23
	Quadratic variance	.00	.00	.22
	Intercept & slope correlation	-.01	.08	.95
	Intercept & quadratic correlation	-.02	.02	.46
	Slope & quadratic correlation	-.02	.02	.34
	Residual variance	.19	.01	.00

Theoretical plausibility. The linear model with significant positive change over time is consistent with the theories presented in the emotional intelligence literature that EI increases during adolescence. The very small slope and little change that is seen over time in this sample is also consistent with the theoretical notion that the stress these girls encounter in their daily lives could result in little to no increase in stress management skills over time.

The quadratic model is not supported by the theories of linear change in stress management skills (EI) over time during adolescence. However, it was possible that there could be differential development of stress management skills across the adolescent years, which was why, in addition to the evidence from the initial data analysis, this model of growth was tested

Statistical fit. Three models were tested, beginning with Model 1, the no-growth model, which was the simplest with only intercept parameters. This no-growth model was built upon by adding slope parameters to create Model 2, a linear model of growth over time. As noted in Table 4.13, Model 2 had slightly better AIC and BIC fit statistics than Model 1. Model 2 also had a significant RMSEA while Model 1 did not.

Model 3, a trajectory of quadratic growth over time, was modeled based on the R^2 statistical fit results from the ordinary least squares regression in the initial data analysis. In this model, a quadratic term was added to the intercept and slope contained in the linear model. When Model 3 was tested in M*plus* the χ^2, AIC and RMSEA all indicated a better fit to the data than Model 2. The BIC was the only fit statistic that indicated the linear model might provide a slightly better fit to the data than the quadratic model. Based on model fit statistics alone, it appears that the quadratic model should be chosen.

Model selection. The quadratic model appeared to provide a superior overall fit to the data than either the no-growth or linear constrained models (Table 4.10). However, the quadratic model had a non-significant mean and variance for the quadratic term (Table 4.11), indicating that this model does not significantly predict quadratic change in this sample of girls and making the quadratic term in this model untenable (Li et al., 2000). In comparison, the linear model was able to significantly predict linear change in girls from the ages 14 to 19 years. It is possible that the quadratic model provided better fit to the data because it was over-specified. This means that adding the quadratic term to the model allowed a better fit, but that could have been an artifact of having an additional term in the model and not due to actual change in the study sample. It is also possible that the girls in the current sample do change in a quadratic manner, but that the sample size is not large enough to produce a significant quadratic term, due to the extra parameters that are required in this model versus the relatively small number of participants.

Based on theory and model parameter estimates, the linear model of change is the best choice for the current accelerated cohort sample. While model fit statistics slightly favor the quadratic model, differences in overall fit are not enough to ignore the other information that supports a linear model. In addition, the linear model is more parsimonious than the quadratic model, which, as previously mentioned, makes this model more desirable. For these reasons, the linear model of change was chosen as the final model. M*plus* output for this model are shown in Appendix D.

This final linear model converged, providing evidence that the accelerated cohort design was appropriate in this sample of girls and that these girls' stress management skills change linearly over time. The significant mean intercept of 2.47 indicated that, on average, girls at age 14 (the initial age modeled and the age which time is centered at) have a moderate amount of stress management skills. The significant positive slope indicates that these high risk girls exhibited increases in stress management skills over time. However, this increase was very small at 0.08 per year, meaning that increases in stress management skills, while significant, occur very slowly, with the plotted change appearing close to straight line, as depicted in Figure 4.10. This significant slope also indicates that, on average, older girls begin the study at slightly higher levels of stress management skills than younger girls but that change is consistent across age cohorts.

The variances for the intercept and slope were significant in the linear model (Table 4.11). The relatively large variance for the intercept indicates substantial variation across girls in initial level of stress management skills (S.C. Duncan et al., 2006). The variability around the developmental trajectory appears relatively small, but is significant and almost half the size of the slope. Residual variances indicate variability in both time-specific error and measurement error. Significant residual variances mean that there is a significant portion of the outcome that remains unexplained (Muthén & Muthén, 2010). The smaller the variance, the less measurement error is present, and the more accurate the stress management skills estimate on each occasion is.

The main goal of this study was to determine whether development occurs in stress management skills over time in girls engaged in high-risk sexual behaviors and if change over time was present, whether it was consistent from ages 14 to 19 years. Aim 3 addressed these goals and demonstrated that a common linear trajectory could be used to represent change across age cohorts (Figure 4.10). With the significant variances found in the linear model, the final analysis for this study was a preliminary exploration of whether covariates measured at the first measurement occasion would help explain the variability in stress management skills at age 14 and over time, addressed in Aim 4.

Figure 4.10. Trajectories of average change of stress management skills over time in each cohort and the accelerated cohort design trajectory across cohorts.

Aim 4: Linking baseline indicators of social connectedness and sexual behavior with the linear accelerated cohort model of stress management skills

Aim 4 provides exploratory information on the use of covariates to predict levels of stress management skills at age 14, the initial age in the accelerated cohort model, as well as change in stress management skills over time. The models examined in this aim were a tentative attempt at explaining the variability seen in the trajectory described in aim 3. Due to the tentative nature of the model incorporating covariates, a final model will be chosen based on the results of analysis addressing this aim, but will not be compared with the final model from aim 3. Further discussion of the tentative nature of the covariate model is in Chapter 5.

Incorporation of covariates into the latent growth model. Using the backwards deletion method described in Chapter 3, all baseline covariates (school connectedness, family connectedness, partner communication regarding sexual risk, and number of male sex partners in the six months prior to the baseline survey), were added to the linear model selected in aim 3. Each covariate was regressed on the intercept and slope of the linear model. Each covariate's factor loadings were constrained to be equal across cohorts for the intercept and the slope, separately. As seen in Table 4.12, school connectedness and partner communication regarding sexual risk both met the pre-determined significance level for predicting the level of stress management skills at age 14 ($p < .05$). Partner communication regarding sexual risk also significantly predicted the development of stress management skills over time. Non-significant covariates (family connectedness and number of male sex partners in the six months prior to the baseline survey) were deleted from the final model. In addition, school connectedness was only used to predict the level of stress management skills at age 14 (intercept) in the final model, because it was not a significant predictor of change in stress management skills over time.

Table 4.12

Regression of Covariates on Intercept and Slope Across Cohorts

	Intercept (*p*-value)	**Slope (*p*-value)**
School Connectedness	**0.49 (.01)**	-0.07 (.27)
Family Connectedness	0.15 (.16)	-0.02 (.56)
Partner Communication	**0.35 (.04)**	**-0.11 (.03)**
#Sex Partners	0.04 (.58)	-0.00 (.87)

Note. Significant estimates ($p < .05$) are indicated in bold.

Final model. A linear conditional model with two predictors of stress management skills at age 14, school connectedness and partner communication regarding sexual risk, and one predictor of the change in stress management skills over time, partner communication, was chosen as the final model. M*plus* output for the final model can be found in Appendix E (Muthén & Muthén, 1998-2010). As seen in Table 4.13, the final model provided a good fit to the data, with all fit statistics better than those in a model including all four covariates. According to Preacher et al. (2007), the RMSEA of .08 indicates that this conditional model is a fair fit to the data.

Parameter estimates for this final model are in Table 4.14. In this final model the intercept was no longer significant, indicating that the null hypothesis cannot be ruled out, i.e., that girls who begin the study with values that are not significantly different from zero (or 1, which is the lowest score in the stress management skills scale).

However, the variance of the intercept was significant, which indicated that the covariates may still be significantly predicting the mean intercept, explaining individual differences in predicted mean values of stress management skills at age 14. The significant and positive mean slope indicates that stress management skills increase significantly over time among girls in this sample. The estimated mean slope was larger than in the unconditional linear model chosen in aim 3 ($M = 0.36$), however, because girls may be starting at a level of 1, an increase of 0.36 per year would only result in a level of stress management skills of 2.8 at age 19 (if the girl began at a level of 1 at age 14), which is only slightly higher than the observed mean of 2.74 at age 19. The variance around the slope was significant, but relatively small, at 0.03, which was the same size as the slope variance in the unconditional model.

The covariates significantly predicted both the intercept and the slope. For the intercept at age 14, the significant covariates of school connectedness at 0.37 and partner communication regarding sexual risk at 0.39, indicate that for each unit increase in these covariates, there would be a corresponding increase in stress management skills of 0.37 and 0.39 units, respectively. In addition, partner communication regarding sexual risk was a significant predictor of the slope. This value was negative, indicating that for each 1-unit increase in partner communication, there was a corresponding reduction of 0.13 in the rate of increase of stress management skills over time. The variances were also significant for all variables in this model, indicating that there was still significant unexplained variability among the participants around the intercept at age 14 and the slope of stress management skills over time.

Table 4.13

Model Fit Statistics for All Covariates and Final Linear Model

Model	$\chi 2$ (*df, p*-value)	AIC	BIC	RMSEA (Probability ≤ 0.05)
All covariates	185.02 (*df* = 146, *p* = .02)	1019.50	1058.75	.09 (.07)
Final Model school connectedness and partner communication re: sexual risk only)	131.67 (*df* =111, *p* = .09)	1015.18	1040.42	.08 (.22)

Table 4.14

Parameter Estimates for Final Model

Fixed Effects Across Cohorts	Estimate	Standard Error	*p*-Value
Mean intercept ($\mu 0$)	0.53	0.45	.24
Mean slope ($\mu 1$)	0.36	0.11	.00
Intercept variance	0.41	0.12	.00
Slope variance	0.03	0.01	.03
Intercept & Slope Correlation	-0.07	0.04	.05
School Connectedness on intercept ($\gamma_4 SchlConn_i$)	0.37	0.10	.00
Partner Communication re Sexual Risk on intercept	0.39	0.16	.02
Partner Communication re Sexual Risk on slope	-0.13	0.05	.01
Residual variance	0.20	0.02	.00

Chapter V: Discussion

The overall goal of the current study was to examine the development of one dimension of emotional intelligence, specifically stress management skills, over time from ages 13 to 19 in adolescent girls who engaged in high risk sexual behaviors, determine if growth occurred in these skills over time, and if so, what type of growth. This study also aimed to establish whether, through an accelerated cohort design, the same model of growth could be used over all of the ages represented in the study sample. Another tentative aim of this study was to examine whether theoretically relevant covariates measured at baseline (defined as the first occasion of measurement, although the age of participants varied by cohort) may influence these trajectories.

This study addressed multiple aims in order to achieve its purpose. First, indicators of stress management skills, social connectedness (school and family connectedness), and sexual behavior (number of male sex partners in the six months prior to the start of the study and partner communication related to sexual risk) at baseline were described and relationships among these variables were examined. Next, a preliminary trajectory of stress management skills was created to examine at the type of change that occurred individually and the mean change among age cohorts over time. Third, a developmental trajectory of stress management skills from the ages of 14 through 19 years was modeled using an accelerated cohort design. Finally, a preliminary analysis was completed to determine if indicators of social connectedness and sexual risk could be used to tentatively predict initial stress management skills and change in stress management skills over time.

The current study utilized control data from the *Prime Time* study, a clinic-based youth development intervention that aimed to reduce multiple risk behaviors among teen girls at high risk for early pregnancy and STI. The current study examined data collected on five occasions over 24 months. Of 127 control participants in the *Prime Time* study, information was used from 125 participants after application of exclusion criteria. The sample of girls was, on average, 16 years old at the first survey occasion, although ages ranged from 13 to 17. This sample was ethnically and racially diverse, with characteristics consistent with those girls randomly assigned to the intervention. The characteristics of the overall *Prime Time* study and information on study procedures and recruitment are published elsewhere (Sieving, McMorris, et al., 2011; Sieving, Resnick, et al., 2011).

This chapter will provide a summary and discussion of the results of the study. Limitations of the current study will be addressed with recommendations for future research. Implications for health promotion practice with adolescents will also be discussed.

Aim 1

The objective of aim 1 was to describe each of the variables in the current study and examine the relationships between variables, at baseline (the first survey occasion). This sample of adolescent girls reported moderately high social connections, with higher connections to school than to family. This group of girls reported communicating with their most recent male sex partner regarding sexual risk, but, on average, doing so after they first had sex with this partner. During the six months prior to the start of the study, this sample of girls reported an average of approximately two male sex partners. At the first study occasion, these girls reported a moderate level of stress management skills, indicating that they engaged in negative stress-related behaviors (e.g., "I fight with people") and had negative feelings (e.g., "I get upset easily") between "sometimes" and "often". Girls who reported higher levels of stress management skills at baseline were also more likely to report greater feelings of connection to both school and family. At baseline, stress management skills were not related to either of the study's sexual behavior variables.

These findings provided mixed preliminary support for the conceptual model guiding this study (Figure 2.1). According to the social development model (SDM) and attachment theory, which provided theoretical underpinnings for the current study, girls who engage in high risk sexual behaviors will most likely come from high risk environments that have limited opportunities for meaningful involvement, positive skill development, and positive feedback; thus, these girls' ability to attach to family and school as well as to romantic partners will be limited (Catalano & Hawkins, 1996; Hawkins & Weis, 1985; Hazan & Shaver, 1987; Hunt & Evans, 2004; Lonczak et al., 2001; United Nations, 2003). The moderately high perceived connections to school reported by these girls, indicates that the girls in this sample are capable of establishing pro-social bonds with school. However, there appears to be wide variability in their bonding capacity, evidenced by a large standard deviation. The strong correlation between school connectedness and stress management skills fits with the study's conceptual model that attachments to prosocial individuals and institutions will promote development of emotional intelligence skills. The study's other social connectedness variable, family connectedness, was lower, on average, than school connectedness in the current sample. In addition, a larger standard deviation, equivalent to almost 25% of the range of the scale at 0.90, provided evidence of wide variability in the connection to family perceived by girls in the current sample. Family connectedness was significantly related to stress management skills, supporting the study's conceptual model. The magnitude of this correlation was smaller than the correlation between school connectedness and stress management skills. Differences in magnitude of associations between stress management skills and connections to family and school could occur for a variety of reasons. It is possible that school provides a consistent environment with perceived opportunities for meaningful involvement, positive skill development, and positive feedback that encourage greater stress management skills. A majority of the girls in this study came from disadvantaged socio-economic backgrounds; further, it was distinctly possible that the level of stress and chaos in their home/family environments limited their capacity to provide opportunities encouraging strong stress management skills (Evans, Brooks-Gunn, & Klebanov, 2011). Thus, high levels of family connectedness may not have uniformly promoted strong stress management skills within this sample.

While neither of the sexual behavior variables were significantly correlated with stress management skills at baseline, the relationship between stress management skills and the number of sex partners in the six months prior to the first survey neared significance ($r = -0.17$, $p = 0.064$). This inverse relationship indicated that girls with greater stress management skills tended to report fewer male sex partners in the 6 months prior to the beginning of the study. This association is consistent with previous research linking positive health behaviors with higher levels of EI and with a cross-sectional study with all *Prime Time* participants which found that greater stress management skills were linked with consistent condom use behavior (Charbonneau & Nicol 2002a; Charbonneau & Nicol 2002b; Ciarrochi, Deane, Wilson, & Rickwood, 2002; Ciarrochi, Wilson, Deane, & Rickwood, 2003; Lando-King, Sieving, McMorris, & Pettingell, 2010; Lee & Olszewski-Kubilius 2006; McNeely et al.; Peters, Kranzler, & Rossen, 2009; Resnick et al., 1997; Smith & Sandhu, 2004; Svetaz, Ireland, & Blum, 2000); . Girls with greater stress management skills at baseline may have been able to make decisions not to engage in sex with a new partner despite situation-specific stress. By definition, stress management skills include impulse control and the ability to withstand stressful situations (Parker et al., 2004). In intimate moments, it may be difficult for adolescent girls to consider consequences of having sex with a new partner. Or, it is possible that girls who have greater levels of stress management skills may be better able to handle this type of intimate situation or better able to avoid putting themselves into a situation like this in the first place.

Aim 2

The first objective of aim 2 was to describe stress management skills at each of the five study time points and across age cohorts, as well as to examine auto-correlations of this measure over time. The second objective of aim 2 was to use an initial data analysis to describe individual and group change in stress management skills over time. The results from the initial data analysis were used to determine the models of change to test using the accelerated cohort design (aim 3).

The study's conceptual model was guided by the social development model and attachment theory, focusing on the role of the environment on the development of emotional skills during adolescence. This model was also guided by empirical evidence regarding brain development, specifically the development of emotions during adolescence and the theory that emotional intelligence develops during adolescence (Bar-On, 2006; Cooper et al., 1998; Goleman, 2001; Greenberg et al., 2007; Hazan & Shaver, 1987; Lonczack et al., 2001; Mayer et al., 2008; Yurgelun-Todd, 2007). This trajectory model explicitly incorporates the effects of time and age on the development of stress management skills and implicitly examines the role that adolescent girls' social contexts and sexual behaviors play in this development.

Examining the weighted mean of stress management skills reported across cohorts over time showed that the girls reported a moderate level of stress management skills, with small increases and decreases across ½-year intervals from age 14 to age 19. Stress management skills over time was also examined within age-specific cohorts. Within cohorts, the lowest level of stress management skills occurred among the age 15 cohort at baseline (the first survey occasion). This cohort also exhibited the widest range, or apparent growth, in stress management skills over the two years, going from a low moderate level of 2.36 at baseline to a high moderate level of 2.76 at the fifth survey occasion. The other age-specific cohorts showed less extreme change in stress management skills over time, with most cohorts appearing to remain approximately the same. This initial evidence supported the notion that stress management skills may change over time. These strong correlations were also expected given the repeated use of the same measurement of stress management skills over time. The stability of this measure in an adolescent population has not previously been shown in longitudinal research. This means that it is not clear that the measurement of emotional intelligence at age 14 is the same as the measurement of EI at age 19.

In the full sample, stress management skills had strong auto-correlations across the study's five time points. However, given the large number of correlations tested in the full sample and ach individual cohort, it was difficult to interpret the significant *p*-values, and these correlations may be nominal at best. In this case, the patterns of correlations may provide more information than the significance level of the correlations. The patterns of correlations were slightly different over time in each of the age cohorts. These correlations ranged from a low of four positive and significant correlations for the age 16 cohort, to a high with measures at all five time points significantly related to the others for the age 15 cohort.

Auto-correlations of stress management skills were positive across all cohorts and occasions. This means that greater stress management skills at one time point corresponded to greater stress management skills at other time points. The majority of these correlations were also significant, although as mentioned previously, this may not be statistically meaningful given the large number of correlations tested. Additionally, the pattern of correlations showed that measures that occurred closer together in time were larger. This relationship among time points makes intuitive sense, that there would be less change in stress management skills over a period of six months than over a year or longer. This finding may also support gradual development of stress management skills over time.

Initial data analysis. Initial data analysis using ordinary least squares (OLS) regression was conducted to examine individual change along with the average initial level of stress management skills and rate of change in the full sample and in each cohort, to inform growth trajectories to be modeled in aim 3 analyses. The age 13 cohort was removed from this analysis due to the small number of girls who were 13 at the beginning of the study.

This analysis showed that girls began the study with different levels of stress management skills and changed differently over time. Upon visual inspection, linear models of change in stress management skills appeared to fit the data points for some girls, while quadratic models appeared to be a better fit for other girls. In order to determine if the quadratic model should be retained for further testing in aim 3, goodness-of-fit of the linear and quadratic models were tested. This was assessed by examining the R^2 for each participant. A stem-and-leaf plot of the R^2 values was used to visually compare the fit of the linear and quadratic models (Figure 4.1). This visual examination revealed some girls whose change over time appeared to fit well in a linear model (higher goodness-of-fit values for the linear model) and some girls whose changed appeared to fit better in the quadratic model (larger R^2 values for quadratic change). Based on the R^2values, the quadratic model was a better fit than the linear model. Based on this examination, it appeared that adding a quadratic term to the original linear model may help to better explain change in stress management skills over time.

The initial data analysis also showed that on average, in the full sample, girls started the study a moderate level of stress management skills, at 2.20 (on a scale with a maximum level of 4.00). However, the girls varied greatly around this mean, as evidenced by the large standard deviation of 1.76, which is almost as large as the level of stress management skills. The standard deviations, and therefore the variability around the initial levels of stress management skills, were relatively large in each cohort, but especially large in the age 17 cohort at 2.21, with a mean of only 2.28.

Intercepts and slopes of OLS stress management skills models were significantly correlated in the full sample and in each age cohort. These correlations were all negative, suggesting that girls who had greater stress management skills at the beginning of the study changed less over time (Bleise & Ployhart, 2002). The age 17 cohort had the largest correlation, with an almost 1:1 relationship between the fitted intercept and the slope at $r = -.97$. This suggests that 17 year old girls who began the study with high levels of stress management skills tended to increase very little over time. However, this large correlation could also be due to a ceiling effect in the stress management skills scale (Hedeker, 2004). With the large standard deviation in the age 17 cohort the vast majority of participants began the study with a level of stress management skill between 0.07 and 4.00 (one standard deviation above and below the mean of 2.28), making it possible that there was a ceiling effect present for some, but not all participants. If there was a ceiling effect for the age 17 cohort this may affect the linear model results and interpretation of linear change over time. This would also call into question how this cohort fit with the other cohorts in a linear accelerated cohort design model. However, examination of the age 17 cohort graph shows that girls who began at the highest levels of stress management skills appeared to decrease quickly over time, making the ceiling effect less likely.

The evidence from this initial data analysis and exploration of stress management skills across the study time points indicates that there is wide variability in the initial level of stress management skills and variability in the way girls change over time. This evidence suggests that it is likely that adding a quadratic term to the linear equation will aid in the prediction of the stress management skills trajectory. Although this type of change is not directly supported by theoretical notions about development of emotional intelligence, it remains possible that stress could result in development that is not consistent over time. The variety of change exhibited by the girls in the current study, made explicit in the graphs for each cohort, may mean that this sample of girls will not show change over time; this is also why a model with no change in stress management skills over time was chosen as well.

Aim 3

Aim 3 addresses the main goal of the current study, determining whether growth occurred in stress management skills over time in adolescent girls engaged in high risk sexual behaviors, and if so, what type of growth. While emotional intelligence theoretically increases during adolescence, this increase has yet to be shown empirically (Bar-On, 2006; Goleman, 2001; Matthews, Roberts, & Zeidner; Mayer, Salovey, & Caruso. 2008). The objective of aim 3 was to use an accelerated cohort design to model change in stress management skills. An accelerated cohort design models stress management skills trajectories from each cohort by using periods of overlap between cohorts. The first step in aim 3 analysis was to visually examine the OLS regression of no-change, linear, and quadratic growth curves from aim 2 (Figures 4.4 – 4.6). These curves provided an initial examination of the cohort-specific plots to be examined for periods of overlap. While there was some overlap, which varied by the type of change being modeled and cohort; the age 14 cohort appeared to change differently than the rest of the cohorts and showed no periods of overlap regardless of the type of change being modeled. In fact, in the graph of the linear OLS regression by cohort, the age 14 cohort appeared to start at about the same level as the age 16 cohort, increase at a greater rate than the other cohorts and end with a higher level of stress management skills than the other cohorts. These results run counter to the theory of development of emotional intelligence during adolescence and to empirical evidence regarding the development of the adolescent brain (Bar-On, 2006; Dempster & Corkill, 1999; Goleman, 2001; Matthews, Roberts, & Zeidner; Mayer, Salovey, & Caruso. 2008; Yurgelun-Todd, 2007). As adolescents age, there should be corresponding increases in emotional intelligence scores, but it appears that in this sample of adolescents the youngest participants are the ones who have the best stress management skills. On the other hand, even the age 14 cohort displays growth in stress management skills over time, which does support the theory of development. These results are also based on the initial data analysis and only intended to provide a first look at the data, because OLS regression does not take into account the dependency among data points that usually occurs in longitudinal data, where residuals are often auto-correlated and heteroscedastic over time within individuals (Singer & Willett, 2003). According to Singer and Willett (2003) this type of analysis is only intended to "reveal general patterns [and] provide insight into functional form" (p. 16).

The next step in the preliminary analysis was to examine means and standard deviations from each age cohort along with the weighted means for the entire sample (Table 4.3). Examining the means for a given age across cohorts showed some differences in stress management skills, although many of these differences appeared small. This finding was replicated in the plotted trajectories of mean change over time (Figure 4.9), with differences between cohorts appearing even smaller, with a number of points of overlap between cohorts. The age 14 cohort was differentiated from other graphs in that it appeared to follow a higher trajectory as compared to the other cohorts. However, when the weighted mean was examined, the difference between the age 14 cohort and the weighted mean appeared small. The weighted mean trajectory followed the cohort trajectories very closely, with nearly complete overlap for the ages of 16.5 on. This preliminary evidence for overlap, or convergence, among the age cohorts allowed for empirical testing for convergence using the accelerated cohort design method in M*plus* (Muthén & Muthén, 1998-2010).

Testing for convergence. For each type of growth (i.e., linear growth, quadratic growth, no-growth) an accelerated cohort model provided overall better fit than the respective cohort-specific model (Table 4.13). This finding provided evidence that the cohorts of girls came from the same “true longitudinal population” (S.C. Duncan et al., 2006).

Model evaluation and selection. After determining that models using the accelerated cohort design provided a better fit to the data for each type of growth than the cohort-specific models, goodness-of-fit statistics along with theoretical plausibility were used to determine the type of growth to include in the final model. Both linear and quadratic accelerated cohort models of stress management skills showed good fit to the data. The no-growth model was clearly not a good fit to the data and therefore was not examined further.

Overall model fit statistics appeared to support the choice of a quadratic trajectory as the final model. The quadratic model appeared to fit the data slightly better than the linear model based on χ^2 and AIC model fit statistics. This evidence of better fit for the quadratic model is consistent with the results from the R^2 fit statistics in aim 3. The quadratic model showed further evidence of providing a close fit to the data with a significant RMSEA that was better than in the linear model (although the RMSEA for the linear model would also be considered a close fit; linear model: RMSEA = .047; quadratic model: RMSEA = .00; Preacher et al., 2007). The choice of a quadratic model would not have been consistent with a theory of linear growth of emotional intelligence during adolescence. However, quadratic change, with changes in how stress management skills change during adolescence, could be consistent with the conceptual model as well as empirical evidence on the effect of stressors on brain development, and thus the development of emotional intelligence. Varying levels of pro-social support from family and school (for example, if a girl switched schools during the period of the study– 40% of girls reported attending two or more schools in the past year at baseline) and chronically high levels of environmental stress could lead to varying levels of stressors and changing ability to handle these stressors (Secor-Turner, Garwick, Sieving, & Sepelt, 2011).

Although selection of the quadratic model could be justified through the conceptual model and empirical research, further examination of the parameter estimates for the quadratic model revealed a non-significant mean and variance for the quadratic term, indicating that the model did not significantly predict quadratic change in this sample of girls (Li et al., 2000). In comparison, the linear model significantly predicted linear change in stress management skills over time, as well as the initial level and variance in stress management skills. Therefore, the linear accelerated cohort model, which was also supported by empirical evidence on brain maturation during adolescence and theory about the development of emotional intelligence during adolescence, was chosen as the final unconditional model of growth in stress management skills from age 14 to 19 years.

This model showed a significant, but small, amount of change in stress management skills over time. The positive change is consistent with theories postulating increases in EI over time (Bar-On, 2006; Goleman, 2001; Mayer, Salovey, & Caruso, 2008). The small slope is also consistent with the evidence from the brain and emotional development literature and with the social development model and attachment theory, which indicate that chronic and toxic stress that can effect the development of emotions, in this case leading to little development in the ability to withstand adverse events or stressful situations without falling apart (stress tolerance) and little development in the ability to resist or delay an impulse or to control one’s emotions (impulse control) (Evans, Brooks-Gunn, & Klebanov, 2011; Greenberg, Riggs, & Blair, 2007; Parker et al., 2004).

The linear accelerated cohort model showed significant variance for the intercept and slope (intercept $\sigma_0^2 = .53$, $p < .001$; slope $\sigma_0^2 = .03$, $p = 0.01$). The large variance for the intercept indicates substantial variation across girls in initial levels of stress management skills (S.C. Duncan et al., 2006). This variation may be accounted for, in part, by the different ages that the girls began the study. Assuming that age affects the development of stress management skills, it would make sense that girls in the age 15, age 16, and age 17 cohorts would have levels of stress management skills at the first survey occasion that would all be higher than younger girls. Through examination of the mean stress management skills scores, it does not necessarily appear that older age cohorts systematically began the study with higher levels of stress management skills (especially since it appeared, based on mean observed scores, that the age 14 cohort began the study with the highest levels of stress management skills). It is likely that many more factors contributed to the variation among individuals, including the environment these girls developed in as described in the social development model and attachment theory (Catalano & Hawkins, 1996; Hawkins & Weis, 1985; Hazan & Shaver, 1987). The variance for the slope is nearly half of the change in stress management skills per year, which created a substantial amount of variability around the trajectory of stress management skills over the ages of 14 to 19. The residual variance for stress management skills in the final model was also significant at .20 ($p < .001$). Thus, there is variability in time-specific measures and measurement error, indicating that a portion of the outcome remains unexplained (Muthén & Muthén, 2010).

The main purpose of the current study was to determine if stress management skills changed systematically over time in adolescent girls engaged in high-risk sexual behaviors and whether this change could be represented by a single model across all cohorts. It was determined that a common model could represent change across cohorts and that this change would best be represented by a linear model in the current sample. This ultimately provided support to the theory that stress management skills, and potentially emotional intelligence, increase linearly over time, even with a sample of adolescent girls who are vulnerable to negative health and developmental outcomes (Bar-On, 2006; Goleman, 2001; Mayer, Salovey, & Caruso, 2008; Rosso, Young, Femia, & Yurgelin-Todd, 2004; Yurgelin-Todd, 2007).

However, it is possible that in the population of adolescent girls engaged in high-risk sexual behaviors (from which this study sample was drawn), development of stress management skills proceeds in a manner that would best be described by a quadratic model of change. The large number of parameters required for the quadratic model and the relatively small sample sizes per age cohort could have resulted in a non-significant quadratic term in the quadratic model. On the other hand, the addition of parameters to the quadratic model would be expected to help explain change, whether or not girls actually changed in a quadratic model. When a model has more parameters it can eventually become saturated. A saturated model will always provide a perfect fit to the data (T.E. Duncan & S.C. Duncan, 2004). However, these parameters may provide an artificially good fit and not represent true change in the sample. Further studies are needed to examine both linear and quadratic change in other vulnerable samples of young people, exploring whether linear or quadratic change better explains change in stress management skills over time.

In the final unconditional model, there was significant variation in the intercept and slope which may be explained by theoretically relevant predictors. The next step was a preliminary exploration of whether change in stress management skills could be explained by predictors from the first time point for each age cohort and how these predictors would behave when they were required to predict an intercept backwards in time for all but the age 14 cohort.

Aim 4

The objective of aim 4 was to provide exploratory information on the use of covariates to predict levels of stress management skills at age 14 (the initial age in the accelerated cohort model) as well as change in stress management skills over time. The observed variability around the initial level of stress management skills and the trajectory of stress management skills over time may, in fact, contain valuable information about change (T.E. Duncan & S.C. Duncan, 2004). Covariate predictors can be an important way to help explain this observed variance.

The use of a model incorporating covariates measured at only one time point to predict an intercept at an age that is only observed in one cohort (age 14) in an accelerated cohort design is considered exploratory, with results that can only be characterized as tentative. Other studies have used time-invariant covariates measured at different ages per cohort to essentially predict intercepts backwards in time (e.g., T.E. Duncan, S.C. Duncan, & Hops, 1994; S.C. Duncan & T.E. Duncan, 1994; Orth, Trzesniewski, & Robins, 2010). However, the majority of these studies used covariates, such as gender and race/ethnicity, that cannot, in any traditional sense, vary over time. The current study used covariates that may change over time. Since the change over time in these covariates was not examined, it is possible that cohort effects were present, making the use of models with average levels of the covariates across age cohorts to predict the level of stress management at age 14 untenable. Thus, findings regarding the prediction of the intercept should be interpreted with caution. It may be slightly more plausible to predict change in stress management skills over time using the same set of covariates. The reason for this is that a model predicting change over time incorporates all ages represented and utilizes a trajectory of stress management skills that has been shown to be consistent across cohorts. There is no requirement that this model predicts backwards in time, making the results much more tenable.

Despite the tentative nature of findings related to this aim, the results will be interpreted. The final model included school connectedness and partner communication regarding sexual risk as time invariant predictors of stress management skills at age 14 and partner communication regarding sexual risk as a predictor of change in stress management skills over time. In this model, the mean intercept was non-significant, indicating that the null hypothesis, that girls began the study with values not significantly different from 1 (the lowest possible score on the stress management skills scale), could not be ruled out.

Both school connectedness and partner communication regarding sexual risk predicted the intercept, stress management skills at age 14. It is very possible that these two covariates would be time varying in this sample of girls, making the interpretation of the prediction of an intercept at age 14 difficult. School connectedness may be time-varying in this sample due to the large percentage of girls (40%) who reported attending two or more schools in the year prior to the initial survey. Levels of school connectedness may vary between schools, as differing opportunities for meaningful involvement, positive skill development, and positive feedback vary (Catalano et al.). In addition, it may be difficult to take advantage of opportunities for connections present at a school after attending that school only briefly, especially for teens who may have difficulty building attachments.

Partner communication regarding sexual risk may be even more likely to change over time than school connectedness, because these girls were likely to change sexual partners over time. For example, girls in this sample had an average of about 2 male sex partners in the 6 months prior to the baseline survey. Communicating with one partner about sexual risk does not necessarily mean that a girl will communicate with future partners regarding sexual risk. There are a number of factors that go into this type of discussion, including relationship satisfaction (Widman, Welsh, McNulty, & Little, 2006).

Interpreting school connectedness and partner communication regarding sexual risk as significant predictors of the mean intercept is made even more difficult as the intercept itself was not significant. In other words, it could not be determined that the level of stress management skills at baseline were significantly different than 1. Thus, the predictors correspond to variations in the level of stress management skills at age 14, although the actual value of stress management skills at this age cannot be predicted. School connectedness and partner communication were both significant predictors of stress management skills at age 14 (school connectedness = 0.37 $p < .001$; partner communication = 0.39, $p = .02$). This means that for every 1-unit increase in school connectedness and partner communication at the initial survey point, there was a corresponding increase of 0.37 and 0.39, respectively, in stress management skills. Together, if girls reported the average level of both school connectedness and partner communication regarding sexual risk, they would add 1.49 to their initial level of stress management skills. However, this addition to the initial level of stress management skills would need to be interpreted within the context of the current conditional model, because the use of predictors changes the interpretation of the model parameters. The intercept at age 14 and slope over time now represent the part of the mean level of stress management skills that is not explained by the predictor variables (T.E. Duncan & S.C. Duncan, 2004).

A significant and positive mean slope indicated that stress management skills increased over the ages of 14 to 19 among the girls in this sample. The mean slope was relatively large at 0.36, especially since the mean slope in the unconditional model was

0.08. Given the relatively large slope in this conditional model, it would be easy to assume that girls had a much larger amount of growth per year in stress management skills than suggested in the unconditional model. However, the value and direction of the predictors moderate this apparently large growth per year. Partner communication regarding sexual risk significantly predicted the development in stress management skills over time (slope). Partner communication was a significant predictor of the linear change in stress management skills at -0.13 per year. This indicates that for each 1-unit increase in partner communication, there was a corresponding reduction in the rate of increase of 0.13 in stress management skills over time.

Since the slope is predicted from age in each cohort, these findings may be more tenable because they are not being used to predict a point backwards in time. However, if partner communication regarding sexual risk is, in fact, a time varying covariate, the use of this measure at baseline for each age cohort still may not be the best way to predict change in stress management skills over time. Although a common trajectory was able to model change over time in stress management skills, this does not mean that partner communication regarding sexual risk changes in the same way over time.

The failure of school connectedness to predict stress management skills over time may be a result of the small amount of development in stress management skills over time (0.08 in the unconditional model). Additionally, the differences in patterns of stress management skills over time, as seen in aim 2, may make it difficult for a variable to significantly predict the change in stress management skills in girls who exhibit such a wide variety of change.

Tentative theoretical interpretation of the model incorporating covariates. It may make theoretical sense that school connectedness in these girls significantly predicts stress management skills. The social development model shows that pro-social bonds to school can lead to development of pro-social skills, including stress management skills (Lonczak et al., 2001). The girls in this study reported moderately high levels of school connectedness at 3.10.

The finding that family connectedness significantly predicted neither stress management skills at age 14 nor change in stress management skills over time runs counter to hypotheses based on both the social development model and attachment theory. In particular, the social development model proposes that greater connection with pro-social individuals and institutions will lead to pro-social development. These types of connections should lead to the ability to better handle stress and stressful situations (Bernat & Resnick, 2006; Lonczak et al., 2001; McNeely, Nonnemaker, & Blum, 2002; Resnick, et al., 1997; Svetaz, Ireland, & Blum, 2000; United Nations, 2003). Attachment theory would posit that strong family connections established early in life would lead to greater stress management skills as adolescents develop and their ability to control their impulses theoretically increases. There are a number of reasons why family connectedness may have failed to predict stress management skills, both at the age of 14 and over time. Recall that school connectedness was a significant predictor of stress management skills at age 14. Baseline measures of school connectedness and family connectedness highly correlated ($r = 0.49$, $p < .001$). Thus, it is possible that family connectedness was influential in determining girls' level of stress management skills at age 14 but that school connectedness was more influential. Due to the high correlation between these two measures, school connectedness may have won out in explaining a shared portion of variance in initial levels of stress management skills. It is also possible that schools are uniformly more able to teach stress management than families. Another reason that schools may have been more influential than families in promoting stress management skills is that as individuals move from childhood to adolescence they begin experimenting with an individual identity separate from their family (Steinberg & Morris, 2001). At this point in life, school can provide a large influence. If school presents the opportunities described by the social development model, it may be that this connection helps teen girls develop impulse control and ways to deal with stress, predicting initial levels of stress management skills.

Partner communication regarding sexual risk served as a proxy for the connections and types of relationships that the girls in this study have with their romantic partners. Relationship satisfaction has been found to be significantly related to partner communication about sexual risk. It is likely that relationship satisfaction is related to a secure attachment style as described by attachment theory (Cooper et al., 1998; Hazan & Shaver, 1987). Girls who are able to communicate with their partners regarding sexual risk may show better attachment with their partners and better initial levels of stress management skills and less improvement in stress management skills over time. Having a conversation about sexual risk can be difficult for anyone and may be especially embarrassing for teenagers (Coleman & Ingham, 1999). The ability to have this conversation, regardless of when it occurred in relationship to first sexual intercourse, may indicate that the individual is better able to handle stress at younger ages, but shows less development in stress management skills over time. These apparently contradictory findings should be examined further with partner communication as a time-varying predictor of stress management skills.

Limitations

Several methodological limitations should be noted. This sample may not be generalizable to other adolescent girls, for a variety of reasons. First, this is a high risk population, which was purposely targeted for this study, but should not be considered representative of girls who do not engage in high risk sexual activity. This sample of girls was representative of girls at high risk for early pregnancy and STI seeking treatment at clinics in their schools and community. However, many high risk individuals do not seek treatment, which may mean that this sample of girls is different from other girls who engage in high risk sexual behaviors and do not seek treatment. Nevertheless, this is an important sample, as very little research exists on the effects of emotional intelligence, and specifically stress management skills, in preventing negative sexual health outcomes among high risk adolescents.

The sample size for each age cohort may present a limitation for the current study, for example, making it difficult or impossible to predict quadratic growth curves, related to large number of parameters and small number of participants per cohort. Additionally, the cohort-specific models for both the linear and quadratic change contained matrices that were not positive definite. This result was due having to a greater number of parameters in a model than there were participants in the age cohort sample (T.E. Duncan & S.C. Duncan, 2004). If more participants had been present in each age cohort in this sample there is a possibility that a quadratic model may have provided the best fit to the data.

Another limitation of the current study was the use of time invariant predictors to attempt to predict an intercept that occurred in the past for the majority of participants. Discussion of aim 4 emphasized that the use of a conditional model utilizing time invariant predictors in an accelerated cohort design was exploratory and that the results were tentative. The reason that the use of these predictors is a limitation, when better specification of a model can usually be seen as a strength of a study, is that the predictors were only measured at one point in time while they may, in fact, vary over time. It was beyond the scope of the current study to determine if there were significant and systematic differences between cohorts on these variables or whether the covariate predictors could be modeled similarly. Without information on how, or if, the predictors change over time, using them to estimate a mean intercept at the age of 14 cannot be justified statistically.

Implications

Recommendations for further research. The current study examined a homogeneous sample of girls who are at high risk for negative reproductive health outcomes. These are girls who may be at high risk for not developing emotional intelligence skills, including stress management skills. This was an important area to study, because there was a scarcity of information on how emotional intelligence may develop in this type of high risk population. On the other hand, there is still a paucity of information regarding the development of emotional intelligence during adolescence, in both high risk and low risk groups. In order to better understand the small levels of development seen in the current sample, it is important to study the development of EI over time in a more heterogeneous population, including those who engage in a variety of high risk behaviors, and those adolescents who are considered low risk.

Although emotional intelligence includes other concepts, including adaptability, interpersonal, and intrapersonal intelligence, the current study focused exclusively on the development of stress management skills. In order to truly understand the development of emotional intelligence in adolescence, it would be important to look at all of the skills that make up this concept. These skills could be examined separately or in combination. Both intrapersonal and interpersonal intelligence were also measured in the sample of girls from the *Prime Time* study. Another longitudinal cohort design could be used with girls in the control sample to determine if intra- and inter-personal intelligence skills develop similarly to stress management skills in these girls who engage in high risk sexual behaviors.

Another possibility for future research is comparing development in stress management skills between the control and intervention groups. There is some preliminary evidence that stress management skills was significantly different between these two groups at the 12 month survey (at a level of $p < .001$), even though these groups did not show significant differences at the baseline survey (Sieving, McMorris, et al., 2011). Comparing the trajectory of stress management skills between the two groups to look for continued significant difference could provide evidence regarding the efficacy of an intervention not targeted at emotional intelligence or stress management skills, increasing these skills. Depending on the other effects of the *Prime Time* intervention, this might also provide evidence that stress management skills should be targeted and may be useful in decreasing sexual risk behaviors or in promoting protective sexual behaviors.

Future research could also use time-varying covariates to predict the intercept and slope of stress management skills and other aspects of emotional intelligence. This would also require a larger sample size, because it would dramatically increase the number of parameters in the model.

Further research linking emotional intelligence trajectories with subsequent health-related behaviors could be an important next step in determining the usefulness of EI for adolescent health providers. In other words, does the development of EI affect health behavior outcomes during later adolescence and early adulthood? A number of studies have linked emotional intelligence with positive and negative health behaviors, but the majority of this research has been cross-sectional and therefore cannot address questions of temporal order and causation (Ghee & Johnson, 2008; Hatzenbuehler, McLaughlin, & Nolen-Hoeksema, 2008; Moriarty, Stough, Tidmarsh, Eger, & Dennsion, 2001; Rivers, Brackett, Salovey, & Mayer, 2007; Trinidad & Johnson, 2002). Future research utilizing longitudinal data can examine the contribution of emotional intelligence to subsequent health behaviors. In addition, this type of research could examine whether certain developmental trajectories of emotional intelligence lead to positive health behaviors outcomes and other types of trajectories lead to negative health behaviors outcomes.

Greater understanding of how trajectories of emotional intelligence during middle adolescence lead to health outcomes in later adolescence can be informative for future interventions. It is possible that targeting emotional intelligence during adolescence could lead to positive health behaviors, as well as the other behaviors that have been correlated with EI, including pro-social involvement with school and peers, higher levels of academic achievement, and successful transitions into adulthood. Prior to designing interventions to build emotional intelligence, we must better understand normative development of emotional intelligence and how development of EI relates to health behavior outcomes.

Recommendations for public health nursing practice with adolescents. Stress management skills may provide an important buffer against high-risk environments and exposure to chronic stress. Promoting stress management skills may be important for public health nurses and other professionals working with adolescents, especially adolescents who engage in high risk sexual behaviors.

This study is a first step in research that ultimately aims to inform public health nursing practice. Using a longitudinal design, this study produced initial evidence about the development of emotional intelligence during adolescence information which was previously only available through theory. This study provides critical information about the development of stress management skills in teens who engaged in high risk behaviors, a group of interest to public health nurses. However, more research is needed in this area before evidence-based public health nursing interventions can be developed.

For example, it is important to study development of emotional intelligence in other adolescent populations. For example, the high risk sample of participants in the current study exhibited what appeared to be small amounts of growth in stress management skills over the ages of 14 to 19. However, without studies from other populations, it is impossible to determine if this really was a small amount of development. It is possible that adolescents from a general community-based population would display no change in stress management skills over time. If that were the case, the "small amount" of development seen among the girls in the current study could prove to be a relatively large increase in stress management skills over time.

Nursing practice is informed by the scientific method, where theories are proposed and then tested to determine if they hold true over time and in different populations. Innovations in practice are informed by evidence; innovative practices are examined to determine if they have had desired effects.

While the current study does not lead directly to practice recommendations, it provides evidence for further research which, in turn, may inform public health nursing practice. The current study can be considered “bench” research, providing an important bridge between theoretical assertions about the development of emotional intelligence and future applied research. *If* future research with diverse samples of young people confirms that emotional intelligence develops during adolescence, that specific influences contribute to this development, and that the development of EI leads to positive health outcomes, it may be possible for public health nursing practice to enhance the likelihood of these outcomes through interventions targeting emotional intelligence. For example, school nurses may implement programs in schools that are designed to increase emotional intelligence in all students. Or school nurses may target students displaying negative behaviors or those who come from social environments that contribute to low EI, providing support to increase these students’ emotional intelligence as a strategy to reduce their risk for negative health outcomes.

Conclusion

In conclusion, it appears that an accelerated cohort design can be used in a sample of adolescent girls engaged in high-risk sexual behaviors to model stress management skills over time. There was evidence of a small amount of positive change in stress management skills over the ages of 14 to 19. This change was consistent across age cohorts included in the current sample, indicating that it may be due to actual increase in the population, rather than an artifact of a history effect on a single cohort. This provides evidence that stress management skills, and possibly emotional intelligence increase over time during adolescence. This study provides preliminary evidence regarding the development of stress management skills and emotional intelligence in a population that has not previously been reported on. Further studies could confirm that stress management skills, as well as other aspects of emotional intelligence, increase over time during adolescence, among high risk groups as well as general populations of adolescents.

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Appendix A

Institutional Review Board Approval

The IRB: Human Subjects Committee determined that the referenced study is exempt from review under federal guidelines 45 CFR Part 46.101(b) category #4 EXISTING DATA; RECORDS REVIEW; PATHOLOGICAL SPECIMENS.

Study Number: 1010E92232

Principal Investigator: Elizabeth Lando

Title(s):
Trajectories of Emotional Intelligence in Adolescent Girls who Engage in High Risk Sexual Behaviors [Project of Prime Time: Health Promotion for Multiple Risk Behaviors, IRB #: HS#0601S80947 (R. Sieving, PI)]

This e-mail confirmation is your official University of Minnesota RSPP notification of exemption from full committee review. You will not receive a hard copy or letter. This secure electronic notification between password protected authentications has been deemed by the University of Minnesota to constitute a legal signature.

The study number above is assigned to your research. That number and the title of your study must be used in all communication with the IRB office.

If you requested a waiver of HIPAA Authorization and received this e-mail, the waiver was granted. Please note that under a waiver of the HIPAA Authorization, the HIPAA regulation [164.528] states that the subject has the right to request and receive an accounting of Disclosures of PHI made by the covered entity in the six years prior to the date on which the accounting is requested.

If you are accessing a limited Data Set and received this email, receipt of the Data Use Agreement is acknowledged.

This exemption is valid for five years from the date of this correspondence and will be filed inactive at that time. You will receive a notification prior to inactivation. If this research will extend beyond five years, you must submit a new application to the IRB before the study's expiration date.

Upon receipt of this email, you may begin your research. If you have questions, please call the IRB office at (612) 626-5654.

You may go to the View Completed section of eResearch Central at http://eresearch.umn.edu/ to view further details on your study.

The IRB wishes you success with this research.

Appendix B

Baseline Variables Across Cohorts

	Mean	Standard Deviation	Observed Range of Scores
Variable/Indicator		Age 14 Cohort (*n* = 27)	
School Connectedness	3.12	0.47	2.22-4.00
Family Connectedness	2.92	0.82	1.00-4.00
Partner Communication Re: Sexual Risk	2.23	0.51	1.00-3.00
Number of Sex Partners in Past Six Months	1.69	1.42	1.00-7.00
Stress Management Skills	2.73	0.72	1.33-3.83
Variable/Indicator		Age 15 Cohort (*n* = 30)	
School Connectedness	3.07	0.52	2.00-3.89
Family Connectedness	2.79	0.94	1.00-4.00
Partner Communication Re: Sexual Risk	1.97	0.53	1.14-3.00
Number of Sex Partners in Past Six Months	1.83	1.15	1.00-5.00
Stress Management Skills	2.36	0.65	1.17-3.50
Variable/Indicator		Age 16 Cohort (*n* = 35)	
School Connectedness	3.10	0.50	1.89-4.00
Family Connectedness	2.85	0.87	1.00-4.00
Partner Communication Re: Sexual Risk	2.00	0.53	1.00-3.00
Number of Sex Partners in Past Six Months	1.93	1.50	1.00-7.00
Stress Management Skills	2.52	0.67	1.50-3.83
Variable/Indicator		Age 17 Cohort (*n* = 30)	
School Connectedness	3.13	0.61	2.11-4.00
Family Connectedness	2.74	0.97	1.00-4.00
Partner Communication Re: Sexual Risk	2.28	0.54	1.29-3.00
Number of Sex Partners in Past Six Months	1.57	0.98	1.00-5.50
Stress Management Skills	2.59	0.75	1.00-3.67

Appendix C

Correlations Among Baseline Predictors and Stress Management Skills Across Cohorts

	School Connectedness	Family Connectedness	Partner Communication	Number of Sex Partners[a]	Stress Management Skills
Variable/Indicator			Age 14 Cohort (n = 27)		
School Connectedness	-	.22	-.13	-.35[a]	.33
Family Connectedness		-	0.34	-.25[a]	.50**
Partner Communication			-	-.05[a]	.31
Number of Sex Partners[a]				-	-0.18[a]
Stress Management Skills					-
Variable/Indicator			Age 15 Cohort (n = 30)		
School Connectedness	-	.67**	.09	-.40[a] *	.37*
Family Connectedness		-	.09	-.38[a] *	.36*
Partner Communication			-	-.23[a]	-.03
Number of Sex Partners[a]				-	-.20[a]
Stress Management Skills					-
Variable/Indicator			Age 16 Cohort (n = 35)		
School Connectedness	-	.34*	.41*	-.23[a]	.39*
Family Connectedness		-	.15	-.24[a]	-.08
Partner Communication			-	-.39[a] *	.10
Number of Sex Partners[a]				-	-.23[a]
Stress Management Skills					-
Variable/Indicator			Age 17 Cohort (n = 30)		
School Connectedness	-	.65**	.17	-.17[a]	.56**
Family Connectedness		-	.25	-.12[a]	.51**
Partner Communication			-	.23[a]	-.02
Number of Sex Partners[a]				-	.01[a]
Stress Management Skills					-

[a]Spearman's ρ non-parametric correlation
*$p < 0.05$ **$p < 0.01$

Appendix D: Linear Unconditional Accelerated Cohort Model M*plus* output

```
Mplus VERSION 6.11
MUTHEN & MUTHEN
08/27/2011   4:29 PM

INPUT INSTRUCTIONS

  Title: Equality constraints residuals equal across, linear beginning with Age Cohort 14,
 SMS 8/27/11
  Data: FILE IS C:\Users\Beth\Documents\Dissertation.Spring 2011\Try05JULY2011.dat;
  Variable: NAME = id ageb SEX PCom SchC FamC SMSB SMSS SMSO SMSE SMST;
        USEVARIABLES ARE ageb SMSB SMSS SMSO SMSE SMST;
        MISSING ARE ALL (-99);
        GROUPING IS ageb (14=1 15=2 16=3 17=4);
  Model: int slp |  SMSB@0 SMSS@.5 SMSO@1 SMSE@1.5 SMST@2;
    [int] (1); [slp] (2);
    int (3); slp (4);
    int WITH slp (5);
    SMSB (6); SMSS (6); SMSO (6); SMSE (6); SMST (6);
    Model 1: int slp | SMSB@0 SMSS@.5 SMSO@1 SMSE@1.5 SMST@2;
    Model 2: int slp | SMSB@1 SMSS@1.5 SMSO@2 SMSE@2.5 SMST@3;
    Model 3: int slp | SMSB@2 SMSS@2.5 SMSO@3 SMSE@3.5 SMST@4;
    Model 4: int slp | SMSB@3 SMSS@3.5 SMSO@4 SMSE@4.5 SMST@5;
    Output: SAMPSTAT TECH1 TECH3;



*** WARNING
  Input line exceeded 90 characters. Some input may be truncated.
  Title: Equality constraints resids equal across, beginning with Age Cohort 14, SMS 8/27/
11,
   1 WARNING(S) FOUND IN THE INPUT INSTRUCTIONS



Equality constraints resids equal across, beginning with Age Cohort 14, SMS 8/27/11,

SUMMARY OF ANALYSIS

Number of groups                                                 4
Number of observations
   Group 1                                                      27
   Group 2                                                      30
   Group 3                                                      35
   Group 4                                                      30

Number of dependent variables                                    5
Number of independent variables                                  0
Number of continuous latent variables                            2

Observed dependent variables

  Continuous
   SMSB        SMSS        SMSO        SMSE        SMST

Continuous latent variables
   INT         SLP

Variables with special functions

  Grouping variable     AGEB

Estimator                                                       ML
Information matrix                                        OBSERVED
Maximum number of iterations                                  1000
```

```
Convergence criterion                                          0.500D-04
Maximum number of steepest descent iterations                         20
Maximum number of iterations for H1                                 2000
Convergence criterion for H1                                   0.100D-03

Input data file(s)
  C:\Users\Beth\Documents\Dissertation.Spring 2011\Try05JULY2011.dat

Input data format  FREE


SUMMARY OF DATA

   Group 1
     Number of missing data patterns             3

   Group 2
     Number of missing data patterns             3

   Group 3
     Number of missing data patterns             6

   Group 4
     Number of missing data patterns             3


COVARIANCE COVERAGE OF DATA

Minimum covariance coverage value   0.100


     PROPORTION OF DATA PRESENT FOR 1


           Covariance Coverage
              SMSB          SMSS          SMSO          SMSE          SMST
              ________      ________      ________      ________      ________
 SMSB           1.000
 SMSS           0.926         0.926
 SMSO           0.963         0.889         0.963
 SMSE           0.963         0.889         0.963         0.963
 SMST           1.000         0.926         0.963         0.963         1.000


     PROPORTION OF DATA PRESENT FOR 2


           Covariance Coverage
              SMSB          SMSS          SMSO          SMSE          SMST
              ________      ________      ________      ________      ________
 SMSB           1.000
 SMSS           0.933         0.933
 SMSO           0.967         0.933         0.967
 SMSE           0.967         0.933         0.967         0.967
 SMST           0.967         0.933         0.967         0.967         0.967


     PROPORTION OF DATA PRESENT FOR 3


           Covariance Coverage
              SMSB          SMSS          SMSO          SMSE          SMST
              ________      ________      ________      ________      ________
 SMSB           1.000
```

SMSS	0.914	0.914			
SMSO	0.943	0.914	0.943		
SMSE	0.943	0.886	0.914	0.943	
SMST	0.943	0.886	0.914	0.914	0.943

PROPORTION OF DATA PRESENT FOR 4

Covariance Coverage

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1.000				
SMSS	0.933	0.933			
SMSO	1.000	0.933	1.000		
SMSE	1.000	0.933	1.000	1.000	
SMST	0.967	0.933	0.967	0.967	0.967

SAMPLE STATISTICS

ESTIMATED SAMPLE STATISTICS FOR 1

Means

	SMSB	SMSS	SMSO	SMSE	SMST
1	2.735	2.741	2.766	2.960	2.989

Covariances

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.497				
SMSS	0.247	0.471			
SMSO	0.246	0.302	0.387		
SMSE	0.150	0.238	0.241	0.418	
SMST	0.185	0.224	0.212	0.247	0.303

Correlations

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1.000				
SMSS	0.510	1.000			
SMSO	0.560	0.708	1.000		
SMSE	0.330	0.536	0.599	1.000	
SMST	0.475	0.594	0.620	0.694	1.000

ESTIMATED SAMPLE STATISTICS FOR 2

Means

	SMSB	SMSS	SMSO	SMSE	SMST
1	2.356	2.421	2.530	2.531	2.778

Covariances

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.405				

SMSS	0.288	0.631			
SMSO	0.351	0.386	0.586		
SMSE	0.281	0.428	0.374	0.605	
SMST	0.315	0.364	0.315	0.368	0.547

Correlations

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1.000				
SMSS	0.570	1.000			
SMSO	0.722	0.636	1.000		
SMSE	0.568	0.693	0.628	1.000	
SMST	0.670	0.620	0.556	0.639	1.000

ESTIMATED SAMPLE STATISTICS FOR 3

Means

	SMSB	SMSS	SMSO	SMSE	SMST
1	2.519	2.717	2.721	2.719	2.701

Covariances

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.434				
SMSS	0.198	0.424			
SMSO	0.191	0.150	0.417		
SMSE	0.127	0.101	0.268	0.345	
SMST	0.146	0.134	0.296	0.254	0.425

Correlations

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1.000				
SMSS	0.462	1.000			
SMSO	0.450	0.358	1.000		
SMSE	0.329	0.264	0.706	1.000	
SMST	0.340	0.317	0.704	0.663	1.000

ESTIMATED SAMPLE STATISTICS FOR 4

Means

	SMSB	SMSS	SMSO	SMSE	SMST
1	2.590	2.715	2.700	2.688	2.749

Covariances

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.539				
SMSS	0.308	0.390			
SMSO	0.317	0.266	0.485		
SMSE	0.210	0.215	0.314	0.539	
SMST	0.085	0.132	0.232	0.300	0.549

```
           Correlations
              SMSB          SMSS          SMSO          SMSE          SMST
              ________      ________      ________      ________      ________
 SMSB           1.000
 SMSS           0.672         1.000
 SMSO           0.620         0.612         1.000
 SMSE           0.389         0.469         0.615         1.000
 SMST           0.156         0.284         0.450         0.552         1.000


     MAXIMUM LOG-LIKELIHOOD VALUE FOR THE UNRESTRICTED (H1) MODEL IS    -470.089


THE MODEL ESTIMATION TERMINATED NORMALLY



MODEL FIT INFORMATION

Number of Free Parameters                        6

Loglikelihood

          H0 Value                        -508.795
          H1 Value                        -470.089

Information Criteria

          Akaike (AIC)                    1029.590
          Bayesian (BIC)                  1046.414
          Sample-Size Adjusted BIC        1027.443
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                             77.411
          Degrees of Freedom                    74
          P-Value                           0.3704

Chi-Square Contributions From Each Group

          1                                 24.280
          2                                 19.198
          3                                 18.923
          4                                 15.009

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.039
          90 Percent C.I.                    0.000  0.113
          Probability RMSEA <= .05           0.547

CFI/TLI

          CFI                                0.985
          TLI                                0.992

Chi-Square Test of Model Fit for the Baseline Model

          Value                            271.215
          Degrees of Freedom                    40
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)
```

```
         Value                              0.359


MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Group 1

 INT      |
    SMSB               1.000      0.000    999.000    999.000
    SMSS               1.000      0.000    999.000    999.000
    SMSO               1.000      0.000    999.000    999.000
    SMSE               1.000      0.000    999.000    999.000
    SMST               1.000      0.000    999.000    999.000

 SLP      |
    SMSB               0.000      0.000    999.000    999.000
    SMSS               0.500      0.000    999.000    999.000
    SMSO               1.000      0.000    999.000    999.000
    SMSE               1.500      0.000    999.000    999.000
    SMST               2.000      0.000    999.000    999.000

 INT      WITH
    SLP               -0.094      0.041     -2.288      0.022

 Means
    INT                2.472      0.092     26.874      0.000
    SLP                0.081      0.028      2.848      0.004

 Intercepts
    SMSB               0.000      0.000    999.000    999.000
    SMSS               0.000      0.000    999.000    999.000
    SMSO               0.000      0.000    999.000    999.000
    SMSE               0.000      0.000    999.000    999.000
    SMST               0.000      0.000    999.000    999.000

 Variances
    INT                0.530      0.145      3.653      0.000
    SLP                0.033      0.013      2.485      0.013

 Residual Variances
    SMSB               0.201      0.015     13.202      0.000
    SMSS               0.201      0.015     13.202      0.000
    SMSO               0.201      0.015     13.202      0.000
    SMSE               0.201      0.015     13.202      0.000
    SMST               0.201      0.015     13.202      0.000

Group 2

 INT      |
    SMSB               1.000      0.000    999.000    999.000
    SMSS               1.000      0.000    999.000    999.000
    SMSO               1.000      0.000    999.000    999.000
    SMSE               1.000      0.000    999.000    999.000
    SMST               1.000      0.000    999.000    999.000

 SLP      |
    SMSB               1.000      0.000    999.000    999.000
    SMSS               1.500      0.000    999.000    999.000
    SMSO               2.000      0.000    999.000    999.000
```

```
    SMSE               2.500      0.000    999.000    999.000
    SMST               3.000      0.000    999.000    999.000

 INT      WITH
    SLP               -0.094      0.041     -2.288      0.022

 Means
    INT                2.472      0.092     26.874      0.000
    SLP                0.081      0.028      2.848      0.004

 Intercepts
    SMSB               0.000      0.000    999.000    999.000
    SMSS               0.000      0.000    999.000    999.000
    SMSO               0.000      0.000    999.000    999.000
    SMSE               0.000      0.000    999.000    999.000
    SMST               0.000      0.000    999.000    999.000

 Variances
    INT                0.530      0.145      3.653      0.000
    SLP                0.033      0.013      2.485      0.013

 Residual Variances
    SMSB               0.201      0.015     13.202      0.000
    SMSS               0.201      0.015     13.202      0.000
    SMSO               0.201      0.015     13.202      0.000
    SMSE               0.201      0.015     13.202      0.000
    SMST               0.201      0.015     13.202      0.000

Group 3

 INT      |
    SMSB               1.000      0.000    999.000    999.000
    SMSS               1.000      0.000    999.000    999.000
    SMSO               1.000      0.000    999.000    999.000
    SMSE               1.000      0.000    999.000    999.000
    SMST               1.000      0.000    999.000    999.000

 SLP      |
    SMSB               2.000      0.000    999.000    999.000
    SMSS               2.500      0.000    999.000    999.000
    SMSO               3.000      0.000    999.000    999.000
    SMSE               3.500      0.000    999.000    999.000
    SMST               4.000      0.000    999.000    999.000

 INT      WITH
    SLP               -0.094      0.041     -2.288      0.022

 Means
    INT                2.472      0.092     26.874      0.000
    SLP                0.081      0.028      2.848      0.004

 Intercepts
    SMSB               0.000      0.000    999.000    999.000
    SMSS               0.000      0.000    999.000    999.000
    SMSO               0.000      0.000    999.000    999.000
    SMSE               0.000      0.000    999.000    999.000
    SMST               0.000      0.000    999.000    999.000

 Variances
    INT                0.530      0.145      3.653      0.000
    SLP                0.033      0.013      2.485      0.013

 Residual Variances
    SMSB               0.201      0.015     13.202      0.000
```

```
    SMSS               0.201      0.015     13.202      0.000
    SMSO               0.201      0.015     13.202      0.000
    SMSE               0.201      0.015     13.202      0.000
    SMST               0.201      0.015     13.202      0.000

Group 4

 INT      |
    SMSB               1.000      0.000    999.000    999.000
    SMSS               1.000      0.000    999.000    999.000
    SMSO               1.000      0.000    999.000    999.000
    SMSE               1.000      0.000    999.000    999.000
    SMST               1.000      0.000    999.000    999.000

 SLP      |
    SMSB               3.000      0.000    999.000    999.000
    SMSS               3.500      0.000    999.000    999.000
    SMSO               4.000      0.000    999.000    999.000
    SMSE               4.500      0.000    999.000    999.000
    SMST               5.000      0.000    999.000    999.000

 INT      WITH
    SLP               -0.094      0.041     -2.288      0.022

 Means
    INT                2.472      0.092     26.874      0.000
    SLP                0.081      0.028      2.848      0.004

 Intercepts
    SMSB               0.000      0.000    999.000    999.000
    SMSS               0.000      0.000    999.000    999.000
    SMSO               0.000      0.000    999.000    999.000
    SMSE               0.000      0.000    999.000    999.000
    SMST               0.000      0.000    999.000    999.000

 Variances
    INT                0.530      0.145      3.653      0.000
    SLP                0.033      0.013      2.485      0.013

 Residual Variances
    SMSB               0.201      0.015     13.202      0.000
    SMSS               0.201      0.015     13.202      0.000
    SMSO               0.201      0.015     13.202      0.000
    SMSE               0.201      0.015     13.202      0.000
    SMST               0.201      0.015     13.202      0.000

QUALITY OF NUMERICAL RESULTS

     Condition Number for the Information Matrix              0.527E-03
       (ratio of smallest to largest eigenvalue)


TECHNICAL 1 OUTPUT


     PARAMETER SPECIFICATION FOR 1


           NU
              SMSB          SMSS          SMSO          SMSE          SMST
              ________      ________      ________      ________      ________
      1           0             0             0             0             0
```

LAMBDA

	INT	SLP
SMSB	0	0
SMSS	0	0
SMSO	0	0
SMSE	0	0
SMST	0	0

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1				
SMSS	0	1			
SMSO	0	0	1		
SMSE	0	0	0	1	
SMST	0	0	0	0	1

ALPHA

	INT	SLP
1	2	3

BETA

	INT	SLP
INT	0	0
SLP	0	0

PSI

	INT	SLP
INT	4	
SLP	5	6

PARAMETER SPECIFICATION FOR 2

NU

	SMSB	SMSS	SMSO	SMSE	SMST
1	0	0	0	0	0

LAMBDA

	INT	SLP
SMSB	0	0
SMSS	0	0
SMSO	0	0
SMSE	0	0
SMST	0	0

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1				

```
 SMSS            0          1
 SMSO            0          0          1
 SMSE            0          0          0          1
 SMST            0          0          0          0          1

          ALPHA
             INT        SLP
          --------   --------
      1          2          3

          BETA
             INT        SLP
          --------   --------
 INT             0          0
 SLP             0          0

          PSI
             INT        SLP
          --------   --------
 INT             4
 SLP             5          6

     PARAMETER SPECIFICATION FOR 3

          NU
             SMSB       SMSS       SMSO       SMSE       SMST
          --------   --------   --------   --------   --------
      1          0          0          0          0          0

          LAMBDA
             INT        SLP
          --------   --------
 SMSB            0          0
 SMSS            0          0
 SMSO            0          0
 SMSE            0          0
 SMST            0          0

          THETA
             SMSB       SMSS       SMSO       SMSE       SMST
          --------   --------   --------   --------   --------
 SMSB            1
 SMSS            0          1
 SMSO            0          0          1
 SMSE            0          0          0          1
 SMST            0          0          0          0          1

          ALPHA
             INT        SLP
          --------   --------
      1          2          3

          BETA
             INT        SLP
          --------   --------
```

```
 INT                 0              0
 SLP                 0              0


           PSI
              INT            SLP
              ________       ________
 INT                 4
 SLP                 5              6


     PARAMETER SPECIFICATION FOR 4


           NU
              SMSB           SMSS           SMSO           SMSE           SMST
              ________       ________       ________       ________       ________
      1            0              0              0              0              0


           LAMBDA
              INT            SLP
              ________       ________
 SMSB                0              0
 SMSS                0              0
 SMSO                0              0
 SMSE                0              0
 SMST                0              0


           THETA
              SMSB           SMSS           SMSO           SMSE           SMST
              ________       ________       ________       ________       ________
 SMSB                1
 SMSS                0              1
 SMSO                0              0              1
 SMSE                0              0              0              1
 SMST                0              0              0              0              1


           ALPHA
              INT            SLP
              ________       ________
      1            2              3


           BETA
              INT            SLP
              ________       ________
 INT                 0              0
 SLP                 0              0


           PSI
              INT            SLP
              ________       ________
 INT                 4
 SLP                 5              6


     STARTING VALUES FOR 1


           NU
```

	SMSB	SMSS	SMSO	SMSE	SMST
1	0.000	0.000	0.000	0.000	0.000

LAMBDA

	INT	SLP
SMSB	1.000	0.000
SMSS	1.000	0.500
SMSO	1.000	1.000
SMSE	1.000	1.500
SMST	1.000	2.000

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.258				
SMSS	0.000	0.255			
SMSO	0.000	0.000	0.194		
SMSE	0.000	0.000	0.000	0.206	
SMST	0.000	0.000	0.000	0.000	0.157

ALPHA

	INT	SLP
1	0.000	0.000

BETA

	INT	SLP
INT	0.000	0.000
SLP	0.000	0.000

PSI

	INT	SLP
INT	0.422	
SLP	0.000	0.103

STARTING VALUES FOR 2

NU

	SMSB	SMSS	SMSO	SMSE	SMST
1	0.000	0.000	0.000	0.000	0.000

LAMBDA

	INT	SLP
SMSB	1.000	1.000
SMSS	1.000	1.500
SMSO	1.000	2.000
SMSE	1.000	2.500
SMST	1.000	3.000

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.258				
SMSS	0.000	0.255			
SMSO	0.000	0.000	0.194		
SMSE	0.000	0.000	0.000	0.206	
SMST	0.000	0.000	0.000	0.000	0.157

ALPHA

	INT	SLP
1	0.000	0.000

BETA

	INT	SLP
INT	0.000	0.000
SLP	0.000	0.000

PSI

	INT	SLP
INT	0.422	
SLP	0.000	0.103

STARTING VALUES FOR 3

NU

	SMSB	SMSS	SMSO	SMSE	SMST
1	0.000	0.000	0.000	0.000	0.000

LAMBDA

	INT	SLP
SMSB	1.000	2.000
SMSS	1.000	2.500
SMSO	1.000	3.000
SMSE	1.000	3.500
SMST	1.000	4.000

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.258				
SMSS	0.000	0.255			
SMSO	0.000	0.000	0.194		
SMSE	0.000	0.000	0.000	0.206	
SMST	0.000	0.000	0.000	0.000	0.157

ALPHA

	INT	SLP
1	0.000	0.000

BETA

	INT	SLP
INT	0.000	0.000
SLP	0.000	0.000

PSI

	INT	SLP
INT	0.422	
SLP	0.000	0.103

STARTING VALUES FOR 4

NU

	SMSB	SMSS	SMSO	SMSE	SMST
1	0.000	0.000	0.000	0.000	0.000

LAMBDA

	INT	SLP
SMSB	1.000	3.000
SMSS	1.000	3.500
SMSO	1.000	4.000
SMSE	1.000	4.500
SMST	1.000	5.000

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.258				
SMSS	0.000	0.255			
SMSO	0.000	0.000	0.194		
SMSE	0.000	0.000	0.000	0.206	
SMST	0.000	0.000	0.000	0.000	0.157

ALPHA

	INT	SLP
1	0.000	0.000

BETA

	INT	SLP
INT	0.000	0.000
SLP	0.000	0.000

PSI

	INT	SLP
INT	0.422	
SLP	0.000	0.103

TECHNICAL 3 OUTPUT

ESTIMATED COVARIANCE MATRIX FOR PARAMETER ESTIMATES

	1	2	3	4	5
1	0.000				
2	0.000	0.008			
3	0.000	-0.002	0.001		
4	-0.001	-0.001	0.000	0.021	
5	0.000	0.000	0.000	-0.006	0.002
6	0.000	0.000	0.000	0.001	-0.001

ESTIMATED COVARIANCE MATRIX FOR PARAMETER ESTIMATES

	6
6	0.000

ESTIMATED CORRELATION MATRIX FOR PARAMETER ESTIMATES

	1	2	3	4	5
1	1.000				
2	0.044	1.000			
3	-0.075	-0.823	1.000		
4	-0.293	-0.055	0.066	1.000	
5	0.321	0.030	-0.044	-0.924	1.000
6	-0.353	-0.018	0.050	0.756	-0.921

ESTIMATED CORRELATION MATRIX FOR PARAMETER ESTIMATES

	6
6	1.000

Beginning Time: 16:29:59
Ending Time: 16:29:59
Elapsed Time: 00:00:00

Appendix E: Linear Accelerated Cohort Model with Covariates M*plus* Output

```
Mplus VERSION 6.11
MUTHEN & MUTHEN
08/31/2011  12:43 PM

INPUT INSTRUCTIONS

  Title: Final model- linear, partner communication & school connectedness accelerated coh
ort design
  Data: FILE IS C:\Users\Beth\Documents\Dissertation.Spring 2011\Final.Mplus.30AUG11.dat;
  Variable: NAME = id ageb SEX SMSB SMSS SMSO SMSE SMST FamC PCom SchC;
        USEVARIABLES ARE ageb SMSB SMSS SMSO SMSE SMST PCom SchC;
        MISSING ARE ALL (-99);
        GROUPING IS ageb (14=1 15=2 16=3 17=4);
  Model: int slp |  SMSB@0 SMSS@.5 SMSO@1 SMSE@1.5 SMST@2;
    [int] (1); [slp] (2);
    int (3); slp (4);
    int WITH slp (5);
    int ON PCom (6);
    int ON SchC (7);
    slp ON PCom (8);
    SMSB (9); SMSS (9); SMSO (9); SMSE (9); SMST (9);
  Model 1: int slp | SMSB@0 SMSS@.5 SMSO@1 SMSE@1.5 SMST@2;
  Model 2: int slp | SMSB@1 SMSS@1.5 SMSO@2 SMSE@2.5 SMST@3;
  Model 3: int slp | SMSB@2 SMSS@2.5 SMSO@3 SMSE@3.5 SMST@4;
  Model 4: int slp | SMSB@3 SMSS@3.5 SMSO@4 SMSE@4.5 SMST@5;
  Output: SAMPSTAT TECH1 TECH3;



*** WARNING
  Input line exceeded 90 characters. Some input may be truncated.
  Title: Final model- linear, partner communication & school connectedness accelerated coh
ort
   1 WARNING(S) FOUND IN THE INPUT INSTRUCTIONS



Final model- linear, partner communication & school connectedness accelerated cohort

SUMMARY OF ANALYSIS

Number of groups                                                 4
Number of observations
   Group 1                                                      27
   Group 2                                                      30
   Group 3                                                      35
   Group 4                                                      30

Number of dependent variables                                    5
Number of independent variables                                  2
Number of continuous latent variables                            2

Observed dependent variables

  Continuous
   SMSB        SMSS        SMSO        SMSE        SMST

Observed independent variables
   PCOM        SCHC

Continuous latent variables
   INT         SLP

Variables with special functions
```

```
  Grouping variable     AGEB

Estimator                                                       ML
Information matrix                                        OBSERVED
Maximum number of iterations                                  1000
Convergence criterion                                    0.500D-04
Maximum number of steepest descent iterations                   20
Maximum number of iterations for H1                           2000
Convergence criterion for H1                             0.100D-03

Input data file(s)
  C:\Users\Beth\Documents\Dissertation.Spring 2011\Final.Mplus.30AUG11.dat

Input data format  FREE


SUMMARY OF DATA

   Group 1
     Number of missing data patterns             3

   Group 2
     Number of missing data patterns             3

   Group 3
     Number of missing data patterns             6

   Group 4
     Number of missing data patterns             3


COVARIANCE COVERAGE OF DATA

Minimum covariance coverage value   0.100


     PROPORTION OF DATA PRESENT FOR 1


           Covariance Coverage
              SMSB          SMSS          SMSO          SMSE          SMST
              ________      ________      ________      ________      ________
 SMSB          1.000
 SMSS          0.926         0.926
 SMSO          0.963         0.889         0.963
 SMSE          0.963         0.889         0.963         0.963
 SMST          1.000         0.926         0.963         0.963         1.000
 PCOM          1.000         0.926         0.963         0.963         1.000
 SCHC          1.000         0.926         0.963         0.963         1.000


           Covariance Coverage
              PCOM          SCHC
              ________      ________
 PCOM          1.000
 SCHC          1.000         1.000


     PROPORTION OF DATA PRESENT FOR 2


           Covariance Coverage
              SMSB          SMSS          SMSO          SMSE          SMST
```

SMSB	1.000				
SMSS	0.933	0.933			
SMSO	0.967	0.933	0.967		
SMSE	0.967	0.933	0.967	0.967	
SMST	0.967	0.933	0.967	0.967	0.967
PCOM	1.000	0.933	0.967	0.967	0.967
SCHC	1.000	0.933	0.967	0.967	0.967

Covariance Coverage

	PCOM	SCHC
PCOM	1.000	
SCHC	1.000	1.000

PROPORTION OF DATA PRESENT FOR 3

Covariance Coverage

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1.000				
SMSS	0.914	0.914			
SMSO	0.943	0.914	0.943		
SMSE	0.943	0.886	0.914	0.943	
SMST	0.943	0.886	0.914	0.914	0.943
PCOM	1.000	0.914	0.943	0.943	0.943
SCHC	1.000	0.914	0.943	0.943	0.943

Covariance Coverage

	PCOM	SCHC
PCOM	1.000	
SCHC	1.000	1.000

PROPORTION OF DATA PRESENT FOR 4

Covariance Coverage

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1.000				
SMSS	0.933	0.933			
SMSO	1.000	0.933	1.000		
SMSE	1.000	0.933	1.000	1.000	
SMST	0.967	0.933	0.967	0.967	0.967
PCOM	1.000	0.933	1.000	1.000	0.967
SCHC	1.000	0.933	1.000	1.000	0.967

Covariance Coverage

	PCOM	SCHC
PCOM	1.000	
SCHC	1.000	1.000

SAMPLE STATISTICS

ESTIMATED SAMPLE STATISTICS FOR 1

Means

	SMSB	SMSS	SMSO	SMSE	SMST
1	2.735	2.736	2.761	2.964	2.989

Means

	PCOM	SCHC
1	2.233	3.120

Covariances

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.497				
SMSS	0.252	0.474			
SMSO	0.251	0.304	0.395		
SMSE	0.146	0.242	0.242	0.411	
SMST	0.185	0.226	0.218	0.243	0.303
PCOM	0.109	0.029	0.082	0.042	0.101
SCHC	0.106	0.022	-0.013	-0.009	0.014

Covariances

	PCOM	SCHC
PCOM	0.253	
SCHC	-0.031	0.216

Correlations

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1.000				
SMSS	0.519	1.000			
SMSO	0.567	0.703	1.000		
SMSE	0.324	0.548	0.599	1.000	
SMST	0.475	0.596	0.631	0.687	1.000
PCOM	0.309	0.085	0.261	0.130	0.366
SCHC	0.323	0.067	-0.044	-0.031	0.053

Correlations

	PCOM	SCHC
PCOM	1.000	
SCHC	-0.133	1.000

ESTIMATED SAMPLE STATISTICS FOR 2

Means

	SMSB	SMSS	SMSO	SMSE	SMST
1	2.356	2.428	2.526	2.534	2.776

Means

	PCOM	SCHC

1	1.973	3.074

Covariances

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.405				
SMSS	0.296	0.642			
SMSO	0.348	0.393	0.581		
SMSE	0.284	0.435	0.374	0.609	
SMST	0.313	0.366	0.311	0.368	0.544
PCOM	-0.001	-0.023	0.079	-0.043	-0.008
SCHC	0.121	0.057	0.129	0.099	0.029

Covariances

	PCOM	SCHC
PCOM	0.267	
SCHC	0.024	0.267

Correlations

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1.000				
SMSS	0.580	1.000			
SMSO	0.719	0.644	1.000		
SMSE	0.572	0.696	0.629	1.000	
SMST	0.668	0.620	0.554	0.640	1.000
PCOM	-0.003	-0.055	0.201	-0.106	-0.021
SCHC	0.368	0.138	0.327	0.245	0.077

Correlations

	PCOM	SCHC
PCOM	1.000	
SCHC	0.092	1.000

ESTIMATED SAMPLE STATISTICS FOR 3

Means

	SMSB	SMSS	SMSO	SMSE	SMST
1	2.519	2.717	2.722	2.716	2.697

Means

	PCOM	SCHC
1	2.003	3.095

Covariances

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.434				
SMSS	0.200	0.424			
SMSO	0.188	0.151	0.412		
SMSE	0.130	0.101	0.267	0.347	

SMST	0.143	0.128	0.293	0.254	0.422
PCOM	0.033	0.080	-0.070	0.004	-0.047
SCHC	0.127	0.108	0.048	0.044	0.079

Covariances

	PCOM	SCHC
PCOM	0.271	
SCHC	0.106	0.246

Correlations

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1.000				
SMSS	0.467	1.000			
SMSO	0.445	0.361	1.000		
SMSE	0.334	0.264	0.706	1.000	
SMST	0.333	0.303	0.704	0.663	1.000
PCOM	0.096	0.236	-0.210	0.012	-0.139
SCHC	0.388	0.333	0.149	0.149	0.244

Correlations

	PCOM	SCHC
PCOM	1.000	
SCHC	0.411	1.000

ESTIMATED SAMPLE STATISTICS FOR 4

Means

	SMSB	SMSS	SMSO	SMSE	SMST
1	2.590	2.727	2.700	2.688	2.744

Means

	PCOM	SCHC
1	2.281	3.134

Covariances

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.539				
SMSS	0.302	0.385			
SMSO	0.317	0.265	0.485		
SMSE	0.210	0.219	0.314	0.539	
SMST	0.093	0.138	0.238	0.298	0.545
PCOM	-0.009	0.100	0.006	0.031	-0.117
SCHC	0.244	0.199	0.201	0.198	0.039

Covariances

	PCOM	SCHC
PCOM	0.276	
SCHC	0.053	0.356

Correlations

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1.000				
SMSS	0.664	1.000			
SMSO	0.620	0.613	1.000		
SMSE	0.389	0.482	0.615	1.000	
SMST	0.172	0.302	0.463	0.550	1.000
PCOM	-0.023	0.308	0.018	0.081	-0.303
SCHC	0.556	0.538	0.484	0.453	0.088

Correlations

	PCOM	SCHC
PCOM	1.000	
SCHC	0.170	1.000

MAXIMUM LOG-LIKELIHOOD VALUE FOR THE UNRESTRICTED (H1) MODEL IS -613.806

THE MODEL ESTIMATION TERMINATED NORMALLY

MODEL FIT INFORMATION

Number of Free Parameters 9

Loglikelihood

H0 Value	-498.591
H1 Value	-432.754

Information Criteria

Akaike (AIC)	1015.181
Bayesian (BIC)	1040.417
Sample-Size Adjusted BIC (n* = (n + 2) / 24)	1011.961

Chi-Square Test of Model Fit

Value	131.672
Degrees of Freedom	111
P-Value	0.0879

Chi-Square Contributions From Each Group

1	37.559
2	30.470
3	29.337
4	34.307

RMSEA (Root Mean Square Error Of Approximation)

Estimate	0.078	
90 Percent C.I.	0.000	0.126
Probability RMSEA <= .05	0.217	

CFI/TLI

```
          CFI                                    0.922
          TLI                                    0.944

Chi-Square Test of Model Fit for the Baseline Model

          Value                                345.885
          Degrees of Freedom                        80
          P-Value                               0.0000

SRMR (Standardized Root Mean Square Residual)

          Value                                  0.260



MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Group 1

 INT      |
    SMSB               1.000      0.000    999.000    999.000
    SMSS               1.000      0.000    999.000    999.000
    SMSO               1.000      0.000    999.000    999.000
    SMSE               1.000      0.000    999.000    999.000
    SMST               1.000      0.000    999.000    999.000

 SLP      |
    SMSB               0.000      0.000    999.000    999.000
    SMSS               0.500      0.000    999.000    999.000
    SMSO               1.000      0.000    999.000    999.000
    SMSE               1.500      0.000    999.000    999.000
    SMST               2.000      0.000    999.000    999.000

 INT      ON
    PCOM               0.387      0.161      2.395      0.017
    SCHC               0.366      0.095      3.862      0.000

 SLP      ON
    PCOM              -0.131      0.051     -2.579      0.010

 INT      WITH
    SLP               -0.071      0.037     -1.937      0.053

 Intercepts
    SMSB               0.000      0.000    999.000    999.000
    SMSS               0.000      0.000    999.000    999.000
    SMSO               0.000      0.000    999.000    999.000
    SMSE               0.000      0.000    999.000    999.000
    SMST               0.000      0.000    999.000    999.000
    INT                0.528      0.446      1.184      0.236
    SLP                0.356      0.112      3.186      0.001

 Residual Variances
    SMSB               0.203      0.015     13.271      0.000
    SMSS               0.203      0.015     13.271      0.000
    SMSO               0.203      0.015     13.271      0.000
    SMSE               0.203      0.015     13.271      0.000
    SMST               0.203      0.015     13.271      0.000
    INT                0.411      0.123      3.341      0.001
    SLP                0.026      0.012      2.171      0.030
```

```
Group 2

 INT      |
    SMSB               1.000      0.000    999.000    999.000
    SMSS               1.000      0.000    999.000    999.000
    SMSO               1.000      0.000    999.000    999.000
    SMSE               1.000      0.000    999.000    999.000
    SMST               1.000      0.000    999.000    999.000

 SLP      |
    SMSB               1.000      0.000    999.000    999.000
    SMSS               1.500      0.000    999.000    999.000
    SMSO               2.000      0.000    999.000    999.000
    SMSE               2.500      0.000    999.000    999.000
    SMST               3.000      0.000    999.000    999.000

 INT      ON
    PCOM               0.387      0.161      2.395      0.017
    SCHC               0.366      0.095      3.862      0.000

 SLP      ON
    PCOM              -0.131      0.051     -2.579      0.010

 INT      WITH
    SLP               -0.071      0.037     -1.937      0.053

 Intercepts
    SMSB               0.000      0.000    999.000    999.000
    SMSS               0.000      0.000    999.000    999.000
    SMSO               0.000      0.000    999.000    999.000
    SMSE               0.000      0.000    999.000    999.000
    SMST               0.000      0.000    999.000    999.000
    INT                0.528      0.446      1.184      0.236
    SLP                0.356      0.112      3.186      0.001

 Residual Variances
    SMSB               0.203      0.015     13.271      0.000
    SMSS               0.203      0.015     13.271      0.000
    SMSO               0.203      0.015     13.271      0.000
    SMSE               0.203      0.015     13.271      0.000
    SMST               0.203      0.015     13.271      0.000
    INT                0.411      0.123      3.341      0.001
    SLP                0.026      0.012      2.171      0.030

Group 3

 INT      |
    SMSB               1.000      0.000    999.000    999.000
    SMSS               1.000      0.000    999.000    999.000
    SMSO               1.000      0.000    999.000    999.000
    SMSE               1.000      0.000    999.000    999.000
    SMST               1.000      0.000    999.000    999.000

 SLP      |
    SMSB               2.000      0.000    999.000    999.000
    SMSS               2.500      0.000    999.000    999.000
    SMSO               3.000      0.000    999.000    999.000
    SMSE               3.500      0.000    999.000    999.000
    SMST               4.000      0.000    999.000    999.000

 INT      ON
    PCOM               0.387      0.161      2.395      0.017
    SCHC               0.366      0.095      3.862      0.000
```

```
 SLP      ON
    PCOM               -0.131      0.051     -2.579      0.010

 INT      WITH
    SLP                -0.071      0.037     -1.937      0.053

 Intercepts
    SMSB                0.000      0.000    999.000    999.000
    SMSS                0.000      0.000    999.000    999.000
    SMSO                0.000      0.000    999.000    999.000
    SMSE                0.000      0.000    999.000    999.000
    SMST                0.000      0.000    999.000    999.000
    INT                 0.528      0.446      1.184      0.236
    SLP                 0.356      0.112      3.186      0.001

 Residual Variances
    SMSB                0.203      0.015     13.271      0.000
    SMSS                0.203      0.015     13.271      0.000
    SMSO                0.203      0.015     13.271      0.000
    SMSE                0.203      0.015     13.271      0.000
    SMST                0.203      0.015     13.271      0.000
    INT                 0.411      0.123      3.341      0.001
    SLP                 0.026      0.012      2.171      0.030

Group 4

 INT      |
    SMSB                1.000      0.000    999.000    999.000
    SMSS                1.000      0.000    999.000    999.000
    SMSO                1.000      0.000    999.000    999.000
    SMSE                1.000      0.000    999.000    999.000
    SMST                1.000      0.000    999.000    999.000

 SLP      |
    SMSB                3.000      0.000    999.000    999.000
    SMSS                3.500      0.000    999.000    999.000
    SMSO                4.000      0.000    999.000    999.000
    SMSE                4.500      0.000    999.000    999.000
    SMST                5.000      0.000    999.000    999.000

 INT      ON
    PCOM                0.387      0.161      2.395      0.017
    SCHC                0.366      0.095      3.862      0.000

 SLP      ON
    PCOM               -0.131      0.051     -2.579      0.010

 INT      WITH
    SLP                -0.071      0.037     -1.937      0.053

 Intercepts
    SMSB                0.000      0.000    999.000    999.000
    SMSS                0.000      0.000    999.000    999.000
    SMSO                0.000      0.000    999.000    999.000
    SMSE                0.000      0.000    999.000    999.000
    SMST                0.000      0.000    999.000    999.000
    INT                 0.528      0.446      1.184      0.236
    SLP                 0.356      0.112      3.186      0.001

 Residual Variances
    SMSB                0.203      0.015     13.271      0.000
    SMSS                0.203      0.015     13.271      0.000
    SMSO                0.203      0.015     13.271      0.000
    SMSE                0.203      0.015     13.271      0.000
```

SMST	0.203	0.015	13.271	0.000
INT	0.411	0.123	3.341	0.001
SLP	0.026	0.012	2.171	0.030

QUALITY OF NUMERICAL RESULTS

Condition Number for the Information Matrix 0.471E-04
(ratio of smallest to largest eigenvalue)

TECHNICAL 1 OUTPUT

PARAMETER SPECIFICATION FOR 1

NU

	SMSB	SMSS	SMSO	SMSE	SMST
1	0	0	0	0	0

NU

	PCOM	SCHC
1	0	0

LAMBDA

	INT	SLP	PCOM	SCHC
SMSB	0	0	0	0
SMSS	0	0	0	0
SMSO	0	0	0	0
SMSE	0	0	0	0
SMST	0	0	0	0
PCOM	0	0	0	0
SCHC	0	0	0	0

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1				
SMSS	0	1			
SMSO	0	0	1		
SMSE	0	0	0	1	
SMST	0	0	0	0	1
PCOM	0	0	0	0	0
SCHC	0	0	0	0	0

THETA

	PCOM	SCHC
PCOM	0	
SCHC	0	0

ALPHA

	INT	SLP	PCOM	SCHC
1	2	3	0	0

BETA

	INT	SLP	PCOM	SCHC
INT	0	0	4	5
SLP	0	0	6	0
PCOM	0	0	0	0
SCHC	0	0	0	0

PSI

	INT	SLP	PCOM	SCHC
INT	7			
SLP	8	9		
PCOM	0	0	0	
SCHC	0	0	0	0

PARAMETER SPECIFICATION FOR 2

NU

	SMSB	SMSS	SMSO	SMSE	SMST
1	0	0	0	0	0

NU

	PCOM	SCHC
1	0	0

LAMBDA

	INT	SLP	PCOM	SCHC
SMSB	0	0	0	0
SMSS	0	0	0	0
SMSO	0	0	0	0
SMSE	0	0	0	0
SMST	0	0	0	0
PCOM	0	0	0	0
SCHC	0	0	0	0

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1				
SMSS	0	1			
SMSO	0	0	1		
SMSE	0	0	0	1	
SMST	0	0	0	0	1
PCOM	0	0	0	0	0
SCHC	0	0	0	0	0

THETA

	PCOM	SCHC
PCOM	0	
SCHC	0	0

ALPHA

	INT	SLP	PCOM	SCHC
1	2	3	0	0

BETA

	INT	SLP	PCOM	SCHC
INT	0	0	4	5
SLP	0	0	6	0
PCOM	0	0	0	0
SCHC	0	0	0	0

PSI

	INT	SLP	PCOM	SCHC
INT	7			
SLP	8	9		
PCOM	0	0	0	
SCHC	0	0	0	0

PARAMETER SPECIFICATION FOR 3

NU

	SMSB	SMSS	SMSO	SMSE	SMST
1	0	0	0	0	0

NU

	PCOM	SCHC
1	0	0

LAMBDA

	INT	SLP	PCOM	SCHC
SMSB	0	0	0	0
SMSS	0	0	0	0
SMSO	0	0	0	0
SMSE	0	0	0	0
SMST	0	0	0	0
PCOM	0	0	0	0
SCHC	0	0	0	0

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1				
SMSS	0	1			
SMSO	0	0	1		
SMSE	0	0	0	1	
SMST	0	0	0	0	1
PCOM	0	0	0	0	0
SCHC	0	0	0	0	0

THETA

	PCOM	SCHC
PCOM	0	
SCHC	0	0

ALPHA

	INT	SLP	PCOM	SCHC
1	2	3	0	0

BETA

	INT	SLP	PCOM	SCHC
INT	0	0	4	5
SLP	0	0	6	0
PCOM	0	0	0	0
SCHC	0	0	0	0

PSI

	INT	SLP	PCOM	SCHC
INT	7			
SLP	8	9		
PCOM	0	0	0	
SCHC	0	0	0	0

PARAMETER SPECIFICATION FOR 4

NU

	SMSB	SMSS	SMSO	SMSE	SMST
1	0	0	0	0	0

NU

	PCOM	SCHC
1	0	0

LAMBDA

	INT	SLP	PCOM	SCHC
SMSB	0	0	0	0
SMSS	0	0	0	0
SMSO	0	0	0	0
SMSE	0	0	0	0
SMST	0	0	0	0
PCOM	0	0	0	0
SCHC	0	0	0	0

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	1				
SMSS	0	1			

SMSO	0	0	1		
SMSE	0	0	0	1	
SMST	0	0	0	0	1
PCOM	0	0	0	0	0
SCHC	0	0	0	0	0

THETA

	PCOM	SCHC
PCOM	0	
SCHC	0	0

ALPHA

	INT	SLP	PCOM	SCHC
1	2	3	0	0

BETA

	INT	SLP	PCOM	SCHC
INT	0	0	4	5
SLP	0	0	6	0
PCOM	0	0	0	0
SCHC	0	0	0	0

PSI

	INT	SLP	PCOM	SCHC
INT	7			
SLP	8	9		
PCOM	0	0	0	
SCHC	0	0	0	0

STARTING VALUES FOR 1

NU

	SMSB	SMSS	SMSO	SMSE	SMST
1	0.000	0.000	0.000	0.000	0.000

NU

	PCOM	SCHC
1	0.000	0.000

LAMBDA

	INT	SLP	PCOM	SCHC
SMSB	1.000	0.000	0.000	0.000
SMSS	1.000	0.500	0.000	0.000
SMSO	1.000	1.000	0.000	0.000
SMSE	1.000	1.500	0.000	0.000
SMST	1.000	2.000	0.000	0.000
PCOM	0.000	0.000	1.000	0.000
SCHC	0.000	0.000	0.000	1.000

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.258				
SMSS	0.000	0.255			
SMSO	0.000	0.000	0.194		
SMSE	0.000	0.000	0.000	0.206	
SMST	0.000	0.000	0.000	0.000	0.157
PCOM	0.000	0.000	0.000	0.000	0.000
SCHC	0.000	0.000	0.000	0.000	0.000

THETA

	PCOM	SCHC
PCOM	0.000	
SCHC	0.000	0.000

ALPHA

	INT	SLP	PCOM	SCHC
1	0.000	0.000	2.233	3.120

BETA

	INT	SLP	PCOM	SCHC
INT	0.000	0.000	0.000	0.000
SLP	0.000	0.000	0.000	0.000
PCOM	0.000	0.000	0.000	0.000
SCHC	0.000	0.000	0.000	0.000

PSI

	INT	SLP	PCOM	SCHC
INT	0.422			
SLP	0.000	0.103		
PCOM	0.000	0.000	0.253	
SCHC	0.000	0.000	-0.031	0.216

STARTING VALUES FOR 2

NU

	SMSB	SMSS	SMSO	SMSE	SMST
1	0.000	0.000	0.000	0.000	0.000

NU

	PCOM	SCHC
1	0.000	0.000

LAMBDA

	INT	SLP	PCOM	SCHC
SMSB	1.000	1.000	0.000	0.000
SMSS	1.000	1.500	0.000	0.000

SMSO	1.000	2.000	0.000	0.000
SMSE	1.000	2.500	0.000	0.000
SMST	1.000	3.000	0.000	0.000
PCOM	0.000	0.000	1.000	0.000
SCHC	0.000	0.000	0.000	1.000

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.258				
SMSS	0.000	0.255			
SMSO	0.000	0.000	0.194		
SMSE	0.000	0.000	0.000	0.206	
SMST	0.000	0.000	0.000	0.000	0.157
PCOM	0.000	0.000	0.000	0.000	0.000
SCHC	0.000	0.000	0.000	0.000	0.000

THETA

	PCOM	SCHC
PCOM	0.000	
SCHC	0.000	0.000

ALPHA

	INT	SLP	PCOM	SCHC
1	0.000	0.000	1.973	3.074

BETA

	INT	SLP	PCOM	SCHC
INT	0.000	0.000	0.000	0.000
SLP	0.000	0.000	0.000	0.000
PCOM	0.000	0.000	0.000	0.000
SCHC	0.000	0.000	0.000	0.000

PSI

	INT	SLP	PCOM	SCHC
INT	0.422			
SLP	0.000	0.103		
PCOM	0.000	0.000	0.267	
SCHC	0.000	0.000	0.024	0.267

STARTING VALUES FOR 3

NU

	SMSB	SMSS	SMSO	SMSE	SMST
1	0.000	0.000	0.000	0.000	0.000

NU

	PCOM	SCHC
1	0.000	0.000

LAMBDA

	INT	SLP	PCOM	SCHC
SMSB	1.000	2.000	0.000	0.000
SMSS	1.000	2.500	0.000	0.000
SMSO	1.000	3.000	0.000	0.000
SMSE	1.000	3.500	0.000	0.000
SMST	1.000	4.000	0.000	0.000
PCOM	0.000	0.000	1.000	0.000
SCHC	0.000	0.000	0.000	1.000

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.258				
SMSS	0.000	0.255			
SMSO	0.000	0.000	0.194		
SMSE	0.000	0.000	0.000	0.206	
SMST	0.000	0.000	0.000	0.000	0.157
PCOM	0.000	0.000	0.000	0.000	0.000
SCHC	0.000	0.000	0.000	0.000	0.000

THETA

	PCOM	SCHC
PCOM	0.000	
SCHC	0.000	0.000

ALPHA

	INT	SLP	PCOM	SCHC
1	0.000	0.000	2.003	3.095

BETA

	INT	SLP	PCOM	SCHC
INT	0.000	0.000	0.000	0.000
SLP	0.000	0.000	0.000	0.000
PCOM	0.000	0.000	0.000	0.000
SCHC	0.000	0.000	0.000	0.000

PSI

	INT	SLP	PCOM	SCHC
INT	0.422			
SLP	0.000	0.103		
PCOM	0.000	0.000	0.271	
SCHC	0.000	0.000	0.106	0.246

STARTING VALUES FOR 4

NU

	SMSB	SMSS	SMSO	SMSE	SMST
1	0.000	0.000	0.000	0.000	0.000

NU

	PCOM	SCHC
1	0.000	0.000

LAMBDA

	INT	SLP	PCOM	SCHC
SMSB	1.000	3.000	0.000	0.000
SMSS	1.000	3.500	0.000	0.000
SMSO	1.000	4.000	0.000	0.000
SMSE	1.000	4.500	0.000	0.000
SMST	1.000	5.000	0.000	0.000
PCOM	0.000	0.000	1.000	0.000
SCHC	0.000	0.000	0.000	1.000

THETA

	SMSB	SMSS	SMSO	SMSE	SMST
SMSB	0.258				
SMSS	0.000	0.255			
SMSO	0.000	0.000	0.194		
SMSE	0.000	0.000	0.000	0.206	
SMST	0.000	0.000	0.000	0.000	0.157
PCOM	0.000	0.000	0.000	0.000	0.000
SCHC	0.000	0.000	0.000	0.000	0.000

THETA

	PCOM	SCHC
PCOM	0.000	
SCHC	0.000	0.000

ALPHA

	INT	SLP	PCOM	SCHC
1	0.000	0.000	2.281	3.134

BETA

	INT	SLP	PCOM	SCHC
INT	0.000	0.000	0.000	0.000
SLP	0.000	0.000	0.000	0.000
PCOM	0.000	0.000	0.000	0.000
SCHC	0.000	0.000	0.000	0.000

PSI

	INT	SLP	PCOM	SCHC
INT	0.422			
SLP	0.000	0.103		
PCOM	0.000	0.000	0.276	
SCHC	0.000	0.000	0.053	0.356

TECHNICAL 3 OUTPUT

ESTIMATED COVARIANCE MATRIX FOR PARAMETER ESTIMATES

	1	2	3	4	5
1	0.000				
2	0.000	0.199			
3	0.000	-0.034	0.012		
4	0.000	-0.052	0.014	0.026	
5	0.000	-0.026	0.001	-0.001	0.009
6	0.000	0.015	-0.006	-0.007	0.000
7	-0.001	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000

ESTIMATED COVARIANCE MATRIX FOR PARAMETER ESTIMATES

	6	7	8	9
6	0.003			
7	0.000	0.015		
8	0.000	-0.004	0.001	
9	0.000	0.001	0.000	0.000

ESTIMATED CORRELATION MATRIX FOR PARAMETER ESTIMATES

	1	2	3	4	5
1	1.000				
2	0.009	1.000			
3	0.005	-0.683	1.000		
4	0.000	-0.729	0.792	1.000	
5	0.000	-0.616	0.052	-0.056	1.000
6	-0.024	0.666	-0.970	-0.820	-0.055
7	-0.287	0.008	0.004	0.011	-0.040
8	0.318	-0.001	-0.002	-0.019	0.031
9	-0.364	-0.013	-0.004	0.019	-0.008

ESTIMATED CORRELATION MATRIX FOR PARAMETER ESTIMATES

	6	7	8	9
6	1.000			
7	0.012	1.000		
8	-0.007	-0.925	1.000	
9	0.016	0.759	-0.919	1.000

```
Beginning Time:  12:43:31
   Ending Time:  12:43:31
  Elapsed Time:  00:00:00
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