

**THE MIDDLE SCHOOL EXPERIENCE AND SUBSTANCE USE  
IN EARLY ADOLESCENCE**

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## **ABSTRACT**

Lei Zhang: The Middle School Experience and Substance Use in Early Adolescence  
(Under the direction of Jill Hamm)

The present study examined the relationship between early adolescents' schooling experience and substance use behavior (cigarette lifetime use and alcohol lifetime use) in early adolescence. The purpose of this study was to examine to what extent middle school experience and adjustment in the first-year of middle school (i.e., sixth grade), and overall middle school adjustment from sixth grade to eighth grade, were associated with cigarette/alcohol use in middle school. Specifically, this study was conducted in two steps. First, it investigated the extent to which adjustment in middle school associated with cigarette and alcohol use concurrently and longitudinally for individual adolescents; then it explored the extent to which exposure to risks residing in early adolescents' social contexts in sixth grade associated with cigarette and alcohol use initiation longitudinally throughout the middle school years.

This study used five waves of data from The Context of Adolescent Substance Use Study, which was collected from 2002 to 2005 in three rural counties in North Carolina. Middle school experience was measured by school connectedness and school disengagement. The risks that early adolescents were exposed to in sixth grade consisted of school, family and peer factors. Multiple statistical methods such as logistic regression and growth curve analysis were implemented to test the relations between middle school experience/adjustment

and cigarette/alcohol lifetime use; and survival analysis was conducted to examine the relation between the risk factors and cigarette/alcohol use initiation.

Overall, the results revealed that (1) negative middle school experience in sixth grade was concurrently positively associated with cigarette and alcohol use in sixth grade; (2) negative middle school adjustment throughout the middle school years were longitudinally positively associated with cigarette and alcohol use. The results further indicated that early adolescents who were exposed to more risks in sixth grade initiated smoking faster than those who were exposed to fewer risks.

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## **CHAPTER 1 INTRODUCTION**

Adolescence is a key life stage for shaping health in adulthood and in later life. A broad view of health held by World Health Organization (WHO, 2006) and scholars (e.g., Call, Riedel, Hein, Mcloyd, Petersen & Kipke, 2002; Hurrelmann, 1989) regards health as both a personal and a collective variable, and influenced by physical, psychological and social aspects. This view recognizes contributions to adolescent health coming from adolescent behaviors as well as their social experiences. As one has observed, in today's rapidly changing society, adolescents' health is constantly shaped by biological, personal, and sociocultural influences. The most significant factors to adolescents' health are found in their environments, and in the opportunities for health-enhancing or health compromising behaviors that reside in these contexts (Call et al., 2002). As adolescents continuously interact with their environments and with the people in their daily lives they are exposed to a variety of health risks that are embedded in these social contexts. Health risk refers to any threat to one's immediate or future health and well-being. It constitutes a broad category that can include both health risk factors (e.g., poverty, social isolation) and health risk behaviors<sup>1</sup> (e.g., substance use, violence) (Schulenberg, Maggs, & Hurrelmann, 1997).

Early onset of substance use is one of the health risk behaviors in early adolescence that has a significant impact on young people's lifelong health and well-being in that the age

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<sup>1</sup> Health risks and health risk behaviors are used interchangeably in the following sections.

of substance use initiation affects later substance use behavior. Smokers who initiate smoking at 12 to 13 years of age reach their peak smoking levels earlier and smoke an average of 11-20 cigarettes per day (Chassin, Presson, Pitts, & Sherman, 2000). Early onset of alcohol use is associated with problematic substance use in later adolescence and an increased likelihood of alcohol-related disorders in adulthood (e.g., Grant & Dawson, 1997; Hawkins, Graham, Maguin, Abbott, Hill, & Catalano, 1997). Initiation of cigarette/alcohol use before age 13 is usually the measure of early onset of cigarette/alcohol use, which roughly corresponds to the transition from elementary school to middle school or the beginning of early adolescence. Extensive studies (e.g., Duncan, S., Duncan T., Biglan, & Ary, 1998; Duncan S., Duncan T., & Strycker, 2006) and national surveys (e.g., National Youth Risk Behavior Survey [YRBS], 2007a, 2007b; Johnston, O'Malley, Bachman, & Schulenberg, 2009) have documented that cigarette and alcohol use increases as grade level increases, yet the synchronization process between these substance use behaviors and the experiences in middle school remains unclear, given that the middle school years signify substantial importance in the course of child/adolescent development as a developmental transition period to early adolescence that provides the opportunity for taking on new roles that can alter developmental trajectories, for better or worse (Schulenberg et al., 1997; Seidman & French, 2004).

Various theoretical views are offered to guide research on the relation between the developmental transition, the middle school experience and health risk behaviors. One model based on Cumulative Stress Theory, takes a direct-effect approach and proposes that health risks result from the multiple and simultaneous transitions that occur in a short period time in middle school (Schulenberg et al., 1997). A different model that originates

from studying identity development also takes a direct-effect approach and views that health risk behaviors and risk-taking behaviors are components of negotiating developmental transitions (Schulenberg et al., 1997). The present study took an indirect approach, adopting the Stage-environment Fit model to assess the effect of the middle school experience on health risk behaviors during the transition to early adolescence. The Stage-environment Fit model proposed by Eccles and her colleagues (Eccles & Midgley, 1989; Eccles et al., 1993), emphasizes that the mismatch between the developmental needs of early adolescents and perceived middle school contexts creates early adolescents' adjustment difficulties. Developmentally appropriate school contexts, that provide opportunities that are sensitive to the developmental tasks, are crucial for positive adaptation and development. From the Stage-environment Fit stand point, the middle school environment fails to support adolescent developmental needs; to some degree, it even undermines positive adjustment (Eccles et al., 1993; Eccles, Flanagan, Lord, Midgley, Roeser & Yee, 1996).

Research documents various declines in academic and psychological domains as a result of a mismatch environment during middle school and beyond (Eccles et al., 1993). The unconstructive school contexts to a great degree are reflected by early adolescents' unpleasant school experience and negative perception of school connectedness, including school climate, teacher-student relationship, and teacher support. Accompanied with a decline in sense of school connection, in responding to the mismatch in school contexts, early adolescents' school engagement behaviors that are related to academic values and motivation appear to decrease during middle school as well (Eccles et al., 1993, 1996; Eccles, Lord, Roeser, Barber, & Jozefowicz, 1997; Zimmer-Gembeck, Chipuer, Hanisch,

Creed & McGregor, 2006; Schmakel, 2008). Evidently, educational studies suggest that lack of school connection and school disengagement are at least partly responsible for declines in academic-related outcome (Juvonen, 2006).

Moreover, findings from substance use research have linked lack of school connectedness with increase in substance use (Battistich & Hom, 1997; Catalan et al., 2004; McNeely & Falci, 2004; Wang, Matthew, Bellamy & James, 2005; Yan, Beck, Howard, Shattuck, & Kerr, 2008). School disengagement behavior is a reliable predictor of substance use (Bryant, Schulenberg, Bachman, O'Malley, & Johnston, 2000; Bryant & Zimmerman, 2002; Bryant, Schulenberg, O'Malley, Bachman & Johnston, 2003). What is missing in extant studies is an assessment of the linkage between the middle school experience and adjustment (as signified by school connectedness and disengagement) and substance use concurrently and longitudinally. Investigation of the effect of the middle school adjustment in relation to substance use extends the application of the Stage-environment Fit model from mainly educational adjustments to health outcomes.

Furthermore, in order to achieve a thorough understanding of proximal environmental risks presented in adolescent world during middle school, aside from examining adolescent experience in school contexts, adolescent family and peer contexts need to be taken into consideration. Drawing from Bronfenbrenner's ecological perspective, family and peer contexts are regarded as two critical microsystems in adolescent life. Literature on substance use clearly demonstrates parental and peer influences on adolescent substance use (Avenevoli & Merikangas, 2003; Kobus, 2003). Inattention to risks in family and peer contexts may result in overestimating the effects of perceived school contexts due to the influence of correlated contexts (Cook, 2003; Cook,

Herman, Phillips, & Settersten, 2002).

As adolescents transform physically and psychologically, the adolescents' families undergo transformation during adolescence as well. Family relationships, parenting style and practice are the significant influence that might enhance adolescent health and psychological adjustment (Galambos & Ehrenberg, 1997). In particular, the negative parent-child relationship, authoritarian parenting style and high level of family conflict are some of the risk factors that can exacerbate adolescents' risks of engaging substance use. Early adolescents exhibit tenuous resistance to peer influence (Steinberg & Monahan, 2007). Examination of peer contexts suggests the connection between the structural aspects of peer network and adolescent substance use (Ennett et al., 2006). In particular when adolescents affiliate with peers from out-of-school social networks or have no friends, they are at higher odds of using substances.(Ennett et al., 2006).

Given the knowledge about the relevant risks in school, family and peer contexts, the multiple-risk approach was used to summarize the risk factors in each of the contexts. Methodologically, it provides a viable summary of background information. Conceptually, this method is congruent with the ecological view about environmental influences in the sense that it helps evaluate joint influence of these contexts on adolescent substance use as well (Sameroff & Fiese, 2000). Application of the multiple-risk approach achieved methodological simplicity and efficiency to investigate risk factors that are salient to the middle school period by moving beyond the influence of well-known risk factors in family and peer contexts.

This current study applied the Stage-environment Fit model to examine substance use behaviors in relation to middle school adjustment and experience. In addition to

investigate the effect of middle school adjustment, this study employed the multiple-risk model to assess early adolescents' substance initiation with respect to their exposure to risks that are salient to the middle school period and present in their proximal social contexts. Cigarette use and alcohol use are the focus of substance use behavior in this study.

### Study Purpose and Research Questions

The purpose of this study was to examine to what extent adjustment, measured by school connectedness and school disengagement, during the first-year of middle school (i.e., sixth grade), and overall middle school adjustment, were associated with cigarette/alcohol use at the end of middle school (i.e., eighth grade). This study was conducted in two steps. First, it examined the extent to which adjustment in middle school associated with cigarette and alcohol use concurrently and longitudinally for individual adolescents; then it explored the extent to which high risk of problematic adjustment in middle school associated with cigarette and alcohol use longitudinally with regard to risk-group membership that are classified based on their experiences in social contexts (i.e., school, family and peer).

This study specifically addressed the following research questions: (1) does middle school adjustment at the transition year (i.e., sixth grade), indicated by school connectedness and school disengagement, associate with cigarette and alcohol use concurrently? (2) Does middle school adjustment in the first year of middle school, indicated by school connectedness and school disengagement, associate with cigarette and alcohol use at the end of eighth grade? (3) How do the trajectories of cigarette and alcohol use develop over time from the first year of middle school (sixth grade) to the end of eighth grade with respect to



sense of school connectedness and school disengagement across the middle school years? (4)

What is the probability of transitioning from non-substance user to substance user from sixth grade to the end of seventh grade with regard to risk-group membership? (5) Is it faster for early adolescents who were in the high-risk group than those who were in the low-risk group to initiate substance use after exposure to risk factors in sixth grade?

## **CHAPTER 2 THEORETICAL FRAMWORK**

Across the middle school years children transform from child into early adolescence. The middle school period is a developmental transition period that signifies substantial importance in the course of child/adolescent development in that it serve as a turning point that can alter developmental trajectories, for better or worse (Schulenberg et al., 1997; Seidman & French, 2004).

This chapter examines the complexity of the middle school experience and adjustment and early adolescents' substance use behaviors. The organization of the chapter is as follows. First, the developmental significance of the middle school period is presented. Then the link between middle school adjustments and substance use is discussed. Finally, experiences with family and peer groups as part of the broad middle school adjustments are considered in relation to substance use in early adolescence.

### **Middle School and Experiences in School Context**

From a developmental perspective, middle school is a major developmental transition period as children are transforming into early adolescents. Like other developmental processes, it is embedded in sociocultural contexts, and involves culturally based, age-related expectations and a normative timetable for social role transitions (Schulenberg et al., 1997).

#### *Individual Development and Middle School*

Throughout the course of child/adolescent development, developmental process is characterized by quantitative and qualitative changes (Piaget, 1983). Quantitative changes manifest as gradual, moment-to-moment changes, taking place in various domains simultaneously. When accumulating over time, they trigger qualitative change, which in turn lead to further changes. “Stage” has been used to describe qualitative changes in structure over a long period time, such as changes observed in biological, cognitive, self and identity process (see Erikson, 1968; Piaget, 1983).

Moving from stage to stage, individual development can be seen as transition. Connell and Furman (1984, p.154) argued that transition is “the occurrence of relatively greater change in characteristic or set of characteristics of an individual, or of a group of individuals”. Transitions in individual development are not discrete and clear cut, but rather slow and gradual. They represent a time of potential transformation in various domains, for example, interpersonal relationships, which may in turn have a long lasting effect on individuals’ well-being (Seidman & French, 2004). A critical transition in individual development is leaving childhood and entering into adolescence. Typically, adolescence is defined as beginning at puberty, a physiological transformation that gives youth adult bodies and alters their own perceptions of themselves as well as other people’s perception of and reaction to them. During this period, cognitive abilities are continuously growing; early adolescents acquire higher-order thinking ability. Over time, these processes will have different rates of change, at times gradual and at times rapid, individually and collectively (Miller, 2002). Regardless of rates of change, children eventually transform into early adolescents. At this time, most leave elementary school and embrace a significant school-related transition in their early life---transition to middle school. Hence, from a

developmental standpoint, middle school can serve as a proxy marker of transition to early adolescence in the process of individual development.

### *Entry to Middle School as an Embedded Ecological Transition*

As the underlying biological blueprint unfolds, young people undergo ecological transition as well when they enter into middle school. According to Bronfenbrenner (1979, p. 26), ecological transition “occurs whenever a person’s position in the ecological environment is altered as a result of a change in role, setting, or both.” Seidman shares a similar view, describing ecological transition as a disturbance in one or more aspects of the constancy of relations or transactions between an individual and one or more dimensions of the context (Seidman, 1988). Ecological transition is often characterized as abrupt and discontinuous due to a change in role, setting, or both, in contrast, most individual developmental transitions are more gradual (Seidman & French, 2004). Middle school reflects the characteristics of ecological transition. Compared with elementary school, middle school environment may seem chaotic. Students switch classrooms, teachers and classmates multiple times a day, making it hard to develop supportive contact between teachers and students (Lynch & Cicchetti, 1997; Reddy, Rhodes, & Mulhall, 2003). Accordingly, the small learning community feeling of elementary school might be lost. In addition, students are confronted with dramatically different social contexts in middle school, which each context has its own norms, expectations, behavioral and social regularities that define the role of student (Seidman & French, 2004). Further, emphasis on standardized testing becomes intensified in middle school (Reddy et al., 2003). Perhaps in response to these changes, students in middle school report a lower quality of life than those in elementary school (Seidman & French, 1997). Social support from teachers and peers, and participations in school activities decrease

as well (Eccles et al., 1993; Lynch & Cicchetti, 1997; Reddy et al., 2003; Seidman, Allen, Aber, Mitchell, & Feinman, 1994). Self-consciousness invokes concerns of peer acceptance and peer status, and the norm of engaging in continuously social comparisons among adolescents can be quite destructive (Cillessen & Mayeux, 2007; Kiefer & Ryan, 2008; Rubin, Bukowski & Parker, 1998).

In short, discontinuity in social settings and change in roles in middle school may bring about adjustment difficulties to some early adolescents (e.g., Erath, Flanagan, & Bierman, 2008; Kiefer & Ryan, 2008; Wentzel, Barry, & Caldwell, 2004). Entry to middle school is embedded within individual development, and characterized as ecological transition. It represents a turning point that provides an opportunity for growth and positive development, thus may also present risks for individuals with dramatic discontinuities in their roles and settings (Roser & Eccles, 1998; Seidman & French, 2004).

*The Intersection of School Ecologies and Individual Development and Its Implication in Adolescent Adjustment and Health*

Children follow a growth trajectory that is driven by biological and cognitive forces, in conjunction with a trajectory of social contextual changes during the school years. When these two trajectories are in synchrony, that is, the social-context-change trajectory responds to the developmental needs of the children, positive developmental outcome can be expected (Eccles et al., 1993). As students enter into middle school, to certain degree, the social-context-change trajectory becomes less responsive to their newly developmental needs. The dramatic individual developmental changes in physical, social and cognitive domains, collide with the impersonal middle school atmosphere. The confluence of the changes, and the discontinuity in setting and social roles create the possibility of experiencing developmental

vulnerability and difficulties, which may lead to engage in health-compromising behaviors (Schulenberg et al., 1997).

Therefore, the significance of the middle school period lies in its distinctive situation as being a developmental transition period with an embedded ecological transition. The confluence of individual development changes and social context generates a unique opportunity for understanding health risks and health-enhancing possibilities that are associated with adjustments present at the transition year and subsequent middle school years. It further provides an occasion for positive and constructive, versus negative and destructive growth, maturation and development.

*Theoretical Views on the Link between the Experiences in the Developmental Transition of Middle School and Health Risks*

The timing and patterns of developmental transitions associated with the transformation from childhood to adulthood have become more diverse and thus less certain (Crockett, 1997; Shanahan, 2000). Experiences and adjustments brought by such transformation may have increased the odds of accompanying health risks (Crockett, 1997). One theoretical view on the relationship between the developmental transition of middle school and health risks draws from Cumulative Stress Theory, and it proposes that health risks result from the multiple and simultaneous transitions that occur in a short period time (Schulenberg et al., 1997). If the extent that developmental transitions contribute to stress exceeds concurrent coping capacities, health risk behaviors may be used as an alternative means of coping. A classical example is found in Simmons and Blyth (1987), who compared the pattern of change on school-related outcomes for adolescents who transitioned from two different school systems. One group moved from sixth to seventh grade in a K-8, 9-12 system, the other made the same transition in K-6, 7-9, 10-12 system. Their findings

suggested that concurrent timing of the middle/junior high school transition and pubertal development accounted for declines in academic-related measures and self-esteem observed in the group who were in K-6 system. This Cumulative-stress model takes a direct-effect approach, emphasizing that the number of transitions may influence health risks (Schulenberg et al., 1997). To counterbalance the multiple-transition effects, the coping capacity of early adolescents must increase.

A different model views that health risk behaviors and risk-taking behaviors are components of negotiating developmental transitions (Schulenberg et al., 1997). This perspective originates from studying identity development. The adolescent years are a time of exciting explorations in identity and looking for answer of “who I am”. Experimenting and exploring alternative identities may involve certain risk taking. Erik Erikson’s (1963, p.11) notion of the adolescent “craving for locomotion” constitutes a form of excessive experimentation, of testing the limits of one’s self, of exploring its multiple possibilities. Failing to explore options may lead to premature identity foreclosure (Erikson, 1968). It seems that the risk-taking identity model suggests a causal link between identity exploration during the developmental transition and risk-taking behaviors. Potential adverse consequences of curbing risk-taking behaviors lie in to what extent risk-taking plays a critical role in the formation of identity. This model also takes a direct-effect approach addressing the impact of middle school experiences on health risks. It is limited, however, in offering an understanding of how the middle school years can be indirectly related to health opportunities.

A third view, the Stage-environment Fit model proposed by Eccles and her colleagues (Eccles & Midgley, 1989; Eccles et al., 1993), suggests that the unique nature of adolescence

results partly from the relation between the developmental needs of adolescents and the social contexts in which they live. Developmentally appropriate school contexts, that provide opportunities that are sensitive to the developmental tasks, are crucial for positive adaptation and development. This model gives central status to person-environment interaction, highlighting that individuals shape their own development as their physical and psychological selves act on and are acted upon the social physical environment (Bronfenbrenner, 1979, 1993). It is essential to recognize that the mismatch between the individual's developmental needs and what is afforded by the context may serve to adversely affect youth's health. The model was tested in the Michigan Study of Adolescent Life Transition (see Eccles et al., 1993). The early adolescents in this study expressed a great desire to exercise their growing cognitive abilities and burgeoning skills, however, this desire to learn was often shattered by large amount of class-work requiring only lower level cognitive skills in middle school classrooms. The mismatch between the students' needs and the teachers' practices played a significant role in undermining adolescents' school-related interest and motivation (Eccles et al., 1993; Eccles et al., 1996).

The mismatch is not only identified in instructional practice but also reflected by students' perceived school connectedness. Sense of school connectedness, relatedness, or belongingness is broadly referred to as a sense of acceptance, respect, support and caring that students have experienced in their school (Juvonen, 2007). The Stage-environment Fit model suggests that a caring and supportive school context is critical when students are confronted with new social and educational demands in the middle school environment (Eccles et al., 1993). This proposition aligns with the theoretical models suggested by Connell (1990) and by Connell and Wellborn (1991) that individuals have a need for relatedness, competence,



and autonomy. The extent to which these needs are met in any specific contexts, such as the school or the family, will determine the individual's engagement in that context. Empirical studies on school connectedness (or school social climate, school belonging) have focused on adolescents' perceptions of multiple dimensions of school context including school social climate, teacher-student relations and teacher support, and the effect of school connection on adaptive schooling adjustment (Juvonen, 2006). And the findings have tied feelings of connectedness/belonging to academic and behavioral outcomes, including academic achievement, school engagement, self-efficacy, task goal orientation and problem behaviors (e.g., Anderman, 2003; Battistich, Solomon, Kim & Watson, 1995; Eccles, Early Fraser, Belansky & McCarthy, 1997; Faircloth & Hamm, 2005; Furrer & Skinner, 2003; Way, Reddy & Rhodes, 2007). The gist of the inquiry places emphasis on the importance of supportive and communal school environment (Juvonen, 2006, 2007). Yet conversely, what early adolescents often experienced in school after advancing to middle school is a less personal, more anonymous and departmentalized environment that fails to support developmental needs (Eccles et al., 1993; Eccles et al., 1996). Consequently, students' feelings of being connected with school plummet as the middle school years go on and the developmental transition process proceeds (Anderman, 2003; Eccles et al., 1993; Eccles et al., 1996; Way, Reddy & Rhodes, 2007). Taken together, it becomes evident that early adolescents' perception of school connectedness can serve as a valid indication of their experiences and adjustments in school to indicate the fit between perceived school contexts and their developmental needs.

The legitimacy and value of student perceptions of classroom/school context has been discussed in the motivational process (Schunk & Meece, 1992). Empirical studies

clearly show that school context (e.g., teachers and teacher behaviors) has an influence on students' perception, which in turn can affect their school engagement and academic achievement (Schunk & Meece, 1992), and self-report of students' perception is predictive of their academic performance (Assor & Connell, 1992). It lends support that the adolescents' perceptions or experiences of the classroom/school environment rather than a more objective account of the school is most relevant for understanding adolescents' adjustment (Connell, 1990; Connell & Wellborn, 1991).

Finally, substantial declines have been documented in academic motivation and interest across adolescence (e.g., Barber & Olsen, 2004; Dotterer, McHale & Crouter, 2009). Such decline in academic interest was often accompanied with school disengagement as indicated by decline in GPA in early adolescence (Dotterer et al., 2009). The Stage-environment Fit model has posited that mismatch in school context and lack of connections with teachers and schools partly account for school disengagement behaviors during the middle school years (Eccles et al., 1993; Juvonen, 2006, 2007). Zimmer-Gembeck and colleagues (Zimmer-Gembeck et al., 2006) demonstrated the effect of the perceived match in school context was mediated through students' school engagement behavior onto academic achievement. Schmakel's (2008) qualitative study also showed how the mismatch between seventh graders' perceived classroom environment and their developmental needs, such as teacher support and student autonomy, were associated with their diminishing academic interest in the middle school years; as a consequence, students became less willing to work hard. Taken together, research suggests that the mismatch in the perceived middle school environment creates adjustment difficulties in early adolescence, and is manifested in at least two aspects: (1) affectively, early adolescents feel less connected with their school; and (2)

behaviorally, they become less engaged in school work. What remains less clear is whether or not these difficult developmental adjustments (i.e., lack of school connectedness and school disengagement) in middle school are related to health risks as the young people advance through the middle school years after the transition year has occurred.

In sum, the Stage-environment Fit model integrates theory about individual psychological development with lived experience in key social/institutional setting like school. It delineates one avenue of indirect effects between the developmental transition — the middle school period and health risks, highlighting two possible directions of health development. One is to provide opportunities to enhance health by matching developmental needs or appropriating challenges for the young person to develop health enhancing behaviors, the other is to minimize the match thus adversely affect health (Schulenberg et al., 1997). It underscores the indirect path among the developing adolescent, the developmental transition and health risks, and can account for health opportunities as well as health risks. As Bronfenbrenner and Crouter (1983) argue, an analysis of the mesosystem, which includes the interacting processes that involve two or more settings containing the developing adolescent, enables researchers to conceive a comprehensive picture about behavior changes as a function of influences emanating from multiple social contexts. Thus, with an emphasis on the interaction process, the stage-environment perspective is adopted to examine potential factors that may contribute to substance use during the middle school years. Although this theoretical perspective has been empirically supported for academic outcomes, it has not been tested for health outcomes. This perspective goes beyond simply acknowledging that both the individual and the environment are key to understanding behavior; it explicitly searches for relevant factors in the environment on the basis of the needs of the developing

individual. Guided by this line of thinking, one can identify features of contexts that allow for healthy choices or (mis)match adolescents' developmental needs with challenges and encouragement in school contexts.

### Family and Peer Contexts during the Middle School Years

In the area of substance research, the influence of family and peer contexts on adolescent substance use are two vital components. Bronfenbrenner's ecological model is relevant in addressing the importance of taking these two contexts into consideration, in addition to the school context, during the middle school years. From an ecological point of view, individual behavior and development are regarded as processes that are inextricably embedded in multiple interrelated social contexts (Bronfenbrenner, 1979). There are four types of embedded contexts affecting development: microsystems, mesosystems, exosystems and macrosystems (Bronfenbrenner, 1979). The microsystems are proximal contexts, including school, family, and peer groups. A developing adolescent has direct contact with the microsystems, frequently interacting with his/her immediate social contexts on a daily basis. Any of these contexts can be constructive or destructive to the youth's positive development (Bronfenbrenner, 1993). A constructive environment consists of people, settings and activities that foster a sense of inclusion and safety, exploration for autonomy and skill development, and invite participation in complex activities; while a deconstructive environment comprises the unpredictable events, or events without clear structures that prohibit manipulation and exploration during the developmental process (Bronfenbrenner, 1993). The family and the peer group, along with the school, represent major catalysts for development as far as these settings encourage, permit, or inhibit youth's engagement and

participation in positive interactions with their environment. Directing attention to multiple contexts allows for detecting both additive and interactive effects of influences radiating from school, family and peer. Moreover, in Bronfenbrenner's (1979) ecological typology a mesosystem is the next higher nested structure, involving the linkages and processes taking place among the microsystems that contains the developing adolescent. The implication for research using ecological paradigm is that adolescents' social contexts may be correlated through both proximal environmental influences and the adolescent who resides in these contexts (Wachs, 2000). As Cook and his colleagues argue (Cook, 2003; Cook et al., 2002) ignorance of such correlation may lead to overestimate the effect of the single measured context.

Similarly, according to the Developmental Science framework, Cairns and his colleagues (Cairns, Gariepy, & Hood, 1990; Mangusson & Cairns, 1996) conceptualize that development proceeds as an integrated system. The development system consists of correlated constraints that are associations between social, environmental and biological force determining individual behavior. These constraints promote stability in development within the system and tend to co-vary, thus the impact of risk factors will be strengthened by the cumulative influences of correlated factors (Farmer, Quinn, Hussey & Holahan, 2001; Wachs, 2000). To lessen the effects of correlated risks and reestablish adaptive behavioral patterns, it is critical to address relevant factors in correlated sub-systems simultaneously (Wachs, 2000). There are ample evidence documenting a variety of risks posed by adolescent family and peer contexts on adolescent substance use (Avenevoli & Merikangas, 2003; Kobus, 2003), the view of correlated constraints suggests that, along with school environment, examinations of relevant factors in family and peer contexts is essential for a

thorough understanding of the association between the middle school adjustment and adolescent substance.

Therefore, within Bronfenbrenner's ecological paradigm, one can expect that during the middle school years, adolescents' school, family and peers work collectively and exert a joint influence on the development of adolescents at a given developmental period. They may present positive factors to facilitate the developmental transition and adaptive development, or impose negative factors to impede the transition and development. Depending upon how the developing adolescent acts on and is acted upon by the social contexts, the joint contextual influence may well extend beyond the transition year. Wachs' (2000) comprehensive review articulates that no single factor is sufficient to explain developmental outcomes and only the study designed to assess biological, psychological, and social influences produces sufficient explanatory power. By identifying and addressing risks in school, family and peer contexts the proposed investigation are inherently grounded regarding theoretical conceptualization and methodological concern.

#### Approach to Assess Multiple Contexts

Methodologically, to investigate multiple contexts simultaneously presents daunting challenges to researchers (Cook, 2003). The multiple-risk model, which is widely applied in risk research, appears to be an effective and parsimonious approach (Gutman, Sameroff, & Cole, 2003; Sameroff, Seifer, Baldwin, & Baldwin, 1993). This model intends to examine the effects of the environmental adversity across nested environmental systems within the ecological framework (Sameroff, 2000; Sameroff & Fiese, 2000). It does not seek to establish a causal link between risk factors and outcome behaviors of interest. Rather, it

views the factors that produce maladaptive variations and the factors that produce adaptive behaviors in development are no different in kind; both of them are represented in the lives of the well developed and the poorly developed\_(Sameroff, 2000). Identifying risk factors is to evaluate their probability of leading to certain undesirable behaviors; such process can lead to a selection of a population in need for intervention treatment (Sameroff, 2000).

This model also assumes that joint influence of the multiple contexts is additive (Cook et al., 2002). Observation is made that proximal environmental influences in multiple contexts have a tendency to co-vary (Wachs, 2000), and risk factors are more likely to cluster in the same individuals (Sameroff et al., 1993; Sameroff & Fiese, 2000). Accordingly risk factors become cumulative in the sense that the presence of clustered risk factors is more likely to be linked to negative outcomes (Gutman et al., 2003). The assertion that it is the number of risk factors in the child's life that lead to negative outcomes rather than a single factor, has won support from risk research literature (e.g., Kraemer, Kazdin, Offord & Kupfer, 2001; Rutter, 1979; Sameroff, 2000; Sameroff & Fiese, 2000; Sameroff & Gutman, 2004; ). The Philadelphia Family Management Study conducted by Furstenberg and his colleagues (Furstenberg, Cook, Eccles, Elder, & Sameroff, 1999) serves as a good example of using the multiple-risk model to assess the effects of multiple environmental risks on adolescent development. The results showed that the relative risk in the high-risk group for negative outcomes (e.g., psychological adjustment, problem behaviors and academic performance) was substantially higher than in the low-risk groups (Furstenberg et al., 1999). Applying the multiple-risk model to investigate the effects of multiple contexts on substance use presents not only conceptual consistency but also methodological simplicity. The conceptual consistency is obtained in that the multiple-risk model is situated within

ecological framework (Sameroff & Fiese, 2000), which is coherent in the overarching ecological framework applied in the present study. Methodologically, the current investigation is interested in the risks to which early adolescents are exposed across contexts during the middle school years. If using a single indicator to represent each risk factor, a large number of predictors in regression analysis would be required, which in turn, require a large sample size to ensure statistical power in analysis (Howell, 2002). The multiple-risk score is used as a single variable and offers a good summary of background variables without sacrificing power (Gutman et al., 2003).

To achieve the purpose of a single multiple-risk indicator, the common practice is to dichotomize the continuous scores on each adversity condition into two groups to represent the presence (1) or absence (0) of risk and then add all dichotomized scores (Sameroff et al., 1993). For example, if a student was assigned 1 to two out of three family risk factors and 0 to the remaining family factor, then this student's risk score is 2. By adopting the multiple-risk model, one can capture developmental vulnerability experienced during the middle school years. Early adolescents can be classified into high- and low-risk groups based on their risk scores. Accordingly, the developmental trajectories of two risk groups can be depicted with respect to substance use.

### School Experiences during the Middle School Years

#### *School Experiences and Perceived School Contexts Identified by Educational Studies*

A large body of research on students' school experiences and perceived school contexts comes from studies of middle/junior high school transition. The transition research has investigated the influence of experiences in middle/junior high school contexts on



school-related academic achievement, motivation and self-esteem. Eccles and her colleagues (e.g., Eccles et al., 1993; Eccles, Lord, Roeser, Barber, & Jozefowicz, 1997) explored the effect of first-year middle school experience and revealed that students' negative perceptions of the middle school environment had a profound influence on students in the first year, for instance, declines in academic motivation/interest and self-esteem (Eccles et al., 1993; Eccles et al., 1996; Eccles, Lord et al., 1997; Roeser, Eccles, & Freedman-Doan, 1999; Roeser, Eccles, & Sameroff, 1998, 2000). These negative perceptions resulted from school context and practice, including school climate, teacher-student relationship, teacher support, and classroom decision-making. They manifested in students' adjustment of feeling not to be part of school, showing less academic interest and less engaging in schoolwork (Eccles et al., 1996). Barber and Olsen (2004) also tested the linkages between perceived school environment and student functioning in the transition year. Overall, their finding indicated perceived change in support from teachers significantly predicted a change in a range of outcome variables including self-esteem and depression. In addition to the transition research on school contexts, Roeser and his collaborators (Roeser & Eccles, 1998; Roeser et al., 1998) labored to examine middle school adjustment and experiences beyond the transition year, they reported that students' perceptions of positive teacher regard and support, comprised of school connectedness research interests, were associated with increases in self-esteem, school motivation and achievement, and inversely related to school truancy in the middle school years.

Depending upon individual characteristics, adjustment in middle school can have long-term implication that leads to further developmental mal-adaptation beyond the middle school years. For instance, students who experienced declines in self-esteem in the first year

of middle school or junior high school were more likely to report lower self-esteem and higher depression when assessed in 10<sup>th</sup> and 12<sup>th</sup> grades (e.g., Eccles, Lord et al., 1997; Roeser et al., 1998, 1999, 2000). In the classic Milwaukee study by Simmons and Blyth (1987), students whose self-esteem and GPA declined between the sixth- and seventh-grade transitions tended to experience further declines by the time they reached 10<sup>th</sup> grade. Seidman and French (2004) have investigated subgroups of adolescents who showed unique configurations of psychosocial functioning and middle school adjustment, and revealed seven trajectories of self-esteem concerning different adaptive behavioral patterns at the transition and beyond. Members of “transition vulnerable” trajectories (“bounce back” and “immediate decline” trajectories) suffered increased stress not only in school but also in their family across the transition year. Five years later, they continued to report lower levels of self-esteem and an increasing engagement in more serious delinquent behaviors.

These studies explored short- and long-term relations among perceived school context changes, the middle school adjustment and school-related outcomes, with a strong focus on self-issues. Yet students’ sense of being connected with school and school disengagement over the middle school years—important indicators of middle school developmental adjustment—have not been fully examined in relation to its long-term effect on adolescents’ middle school adaptation, especially on health outcomes, even though their short-term effects on academic-related outcomes has been documented (Eccles et al., 1993). Some students may or may not immediately experience loss of belongingness in the first year of middle school, there is evidence indicating substantial decline among students in perceived school environment (e.g., lower support from teachers, less respect from teachers) through the grade transition from sixth- to seventh-grade in the same school (Anderman, 2003; Barber & Olsen,

2004; Hamm & Faircloth, 2005). Even after these students moved to eighth grade, they did not perceive much of positive changes in terms of school environment, and their academic performance and participation in school activities were not improved significantly (Barber & Olsen, 2004). Juvonen (2006) concludes that school environment characterized by alienated interpersonal relationship and lack of support do not motivate students to engage in school work, conversely it may increase educational risks. It becomes clear that, of the middle school adjustments and experiences, early adolescent sense of school connectedness and school engagement behaviors can either become protective factors that promote resiliency or serve as risk factors that increase individual vulnerabilities during the middle school years. Subsequently maladaptive adjustments can be exacerbated to lead to negative outcomes later in adolescence (Eccles et al., 1996). There is still much to be learned about the interplay among perceived school contexts in middle school, the middle school adjustment (characterized by school connectedness and school disengagement behavior) and health risks. Examination of substance use literature on perceived school contexts provides further guidance to clarify the linkage between the middle school adjustment and early adolescent substance involvement.

#### *Effects of School Experiences Identified by Substance Use Studies*

Investigation of developmental trajectories of substance use in adolescence reveals that the middle school period is critical in the development of substance use. Research demonstrated that a group of rapid-escalating smokers showed first escalation in middle school years around age 13 (Stanton, Flay, Colder, & Mehta, 2004), while a subgroup of early adolescents with low level of initial alcohol use in sixth grade exhibited a linear increase in the middle school years (Li, Duncan, & Hops, 2001). Yet review of substance use

research indicates there has been little work aimed at the influence of the middle school adjustment on substance use behaviors. A recent study by Estell and his collaborators (Estell, Farmer, Irvin, Thompson, Hutchins & McDonough, 2007) disclosed the linkage between middle school adjustments and substance use in the first year of high school. Not surprisingly, the students with positive adjustment patterns during middle school years had lower substance rates of substance use and better grades in the first year of high school, compared to students who had negative middle school experience. Yet the results were limited by the fact that the study did not report whether or not these students had used substance at any time of the middle school years, making it impossible to comprehend substance use patterns in middle school.

In addition, the most relevant research to the present study is the line of inquiry on the relations between school connectedness and substance use. This conceptual scheme underscores the same conditions that Eccles et al. (1993) have called for in the school environment when children move to the middle school. An earlier cross-sectional study by Battistich and Hom (1997) found lack of sense of community to be associated with various substance use, and delinquency behaviors among a sample of fifth and sixth graders. Over a decade ago, the Seattle Social Development Project was launched to clarify the linkage between early adolescents' prosocial or antisocial behaviors and their social environment (Catalano, Haggerty, Oesterle, Fleming & Hawkins, 2004). The participants were followed from age 11 (fifth grade) up to age 27. School bonding (or school connectedness) indicated those students who felt more connected with their school had lower rates of drinking and smoking initiation, compared with those who did not feel. Bonding to school in fifth grade was associated with delay of drinking initiation, which, in turn, reduced the likelihood of

alcohol misuse in 12th grade. The same held true for smoking initiation. Students who were more attached to school in fifth and sixth grade were less likely to initiate smoking by seventh grade.

Consistent with the previous studies, more recent cross-sectional studies found that being connected to school was negatively associated with substance use (e.g., cigarette and alcohol) across ethnic groups such as African American, Asian, or Latino (Wang et al., 2005; Yan et al., 2008). Furthermore, analysis of the National Longitudinal Study of Adolescent Health (Add Health), a national representative sample, displays a similar trend. Drawing two-wave data from Add Health, McNeely and Falci (2004) demonstrated that adolescents who perceived high social support (e.g., teachers caring about them) were less likely to initiate smoking or drinking.

Moreover, early adolescents who experienced decreased self-esteem, academic motivation and interest as a result of perceived negative school environment during the developmental transition may also experience negative changes in school engagement and values that are linked to motivation and self-esteem (Eccles et al., 1993; Eccles, Lord et al., 1997; Zimmer-Gembeck et al., 2006). When students are not behaviorally or psychologically engaged in school, they are more likely to cut class, act out, fail to complete schoolwork, or misbehave (Steinberg, 1996). Bryant and her colleagues (e.g., Bryant et al., 2000, 2003; Bryant & Zimmerman, 2002) showed that high levels of reported school misbehavior and low levels of academic achievement in early adolescence were associated with high concurrent substance use and increased use over time. These findings support Jessor and Jessor's (1977) problem behavior theory, in which school-related disengagement behaviors may transfer to other settings such as involving substance or other delinquent acts.

They are accorded with earlier studies (e.g., Hawkins, Catalano, & Miller, 1992; Petraitis, Flay, & Miller, 1995), suggesting that negative school experiences and school disengagement behaviors are risk factors for substance use.

Findings from the aforementioned studies are explicit that in schools in which students have a strong sense of community, are more strongly bonded to the school, and are engaged in school, they are less likely to engage in risky behaviors. These studies corroborate Hirsch's (1969) proposition that weak attachments with conventional institutions are an important cause of delinquent behavior among youth. Further, loss of sense of community is heightened during middle school (Seidman & French, 1997). Taken the evidence together, what empirical evidence there is of links between negative experiences and adjustment in the school social contexts (reflected by lack of school connectedness and school disengagement) and higher odds in substance use align with the theoretical expectations proposed by the Stage-environment Fit model. For the study of interest, the question becomes the extent to which lack of school connectedness and school disengagement is accompanied by substance involvement concurrently in the first year of middle school, and longitudinally over the middle school years.

In sum, the unique risk to early adolescents in middle school is likely not only a function of non-supportive school structures but also the confluence of developmental changes occurring in students of this age. Research suggests that entry to middle school marks the beginning of a downward spiral for some early adolescents over the course of middle school, a marked decline in some early adolescents' school grades, intrinsic motivation and self-concepts and self-perceptions (Eccles et al., 1993). The magnitude of this decline is predictive of subsequent school failure and dropout (Eccles, Lord et al., 1997),

although these changes are not extreme for most adolescents. Such a dynamic may extend to health outcomes, as some youth might engage in health comprising behavior as their means of renegotiating to their new environment. This underscores the significance of a caring, supportive school context to adolescent health and well-being. The extent to which the youth respond and adjust to the middle school context contributes to their academic achievement and health (e.g., Roeser et al., 1998, 1999). Empirical findings in substance use literature have noted that adolescents' sense of school connectedness and school disengagement is predictive of substance use (e.g., Battistich & Hom, 1997; Bryant et al., 2000, 2003; Bryant & Zimmerman, 2002; McNeely & Falci, 2004). Altogether, the evidence strongly suggests that school connectedness and disengagement in school over the course of the middle school years may be associated with engagement in substance use. Given that YRBS (2007a, 2007b) estimates that for every one hundred early adolescents before age 13, almost 14 of them have starting smoking and 24 of them have starting drinking, it is worthy effort to investigate (1) if the first year adjustment of middle school had any influence on cigarette and alcohol use concurrently and longitudinally; (2) whether or not the overall middle school adjustment had any associations with cigarette and alcohol use throughout middle school. By clarifying linkages between the middle school adjustments and middle school substance use, and tracking substance involvement through the middle school years, it is also possible to develop intervention program that is responsive to the distinct needs of students with different patterns of adaptation.

### Risk Factors in Family Environment

In the previous sections, school experiences and perceived school contexts are examined to identify risk factors that are salient to positive development during middle school. Among a variety of risks, lack of school connectedness and school disengagement that characterize negative adjustment are recognized. Compared with perceived school contexts, research on family and peer contexts are strongly developed (see reviews Avenevoli & Merikangas, 2003; Kobus, 2003). There is a range of known family and peer factors exerting influences on adolescent substance use such as parent/peer substance use behaviors, parenting practice or peer influence (e.g., Avenevoli & Merikangas, 2003; Bauman, Faris, Ennett, Hussong & Foshee, 2007; Ennett & Bauman, 1993; Ennett et al., 2006; Ennett, Faris, et al., 2008). However it is little known the role of family or peer contexts during the developmental transition of middle school in relation to adolescent substance use. In the following sections issues related to family and peers that may present unique challenges during this period are explored. The risks related to family will be discussed first, then proceeds the risks related to peer groups.

Family and parental influence on adolescents' substance use are investigated under two lines of research: genetic epidemiological studies and social risk-factor research. The former identifies the role of genetic and environmental factors and their interaction in the etiology of diseases or traits, while the latter emphasizes environmental influence (Avenevoli & Merikangas, 2003). The literature relevant to the current study lies in social risk-factor research. This line of inquiry on cigarette and alcohol use has identified parental behaviors in several domains that are related to adolescents' use of cigarette and alcohol. Parents' smoking/drinking behaviors is a consistent predictor of adolescents' substance use behavior (e.g., Johnson and Johnson, 2001; Li, Pentz & Chou, 2002). Inconsistent parenting style and



parenting practice has been linked to increases in adolescent use. This broad category includes parental warmth (Hops, Davis, & Lewin, 1999; Nash, McQueen, & Bray, 2005; White, Johnson, & Buyske, 2000), autonomy granting (Herman, Dornbusch, Herron & Herting, 1997), monitoring (Ary et al., 1999; Connell, Dishion & Deater-Deckard, 2006), and engagement/involvement (Simons-Morton and Chen, 2005), and parent-child conflict (Ary et al., 1999). Yet family environment and parenting at the middle school period is still an uncommon object of study with regard to substance involvement.

While early adolescents are experiencing school changes as transiting to middle school, their family environment is undergoing transformation. Family relationships and parenting styles and practices are among the most significant influences that might enhance the adolescent's health and well-being (Galambos & Ehrenberg, 1997). During early adolescence, children begin to strive for independence, request a voice in family matters and insist on making their own decisions. The Stage-environment Fit model (Eccles et al., 1993) suggests, when there is a lack in fit between adolescents' needs and the opportunities that a particular setting affords, detachment to that setting might develop. It follows, then, that if the family environment is not affording adolescents with reasonable levels of autonomy and warmth, adolescents may turn to a different, and potentially risky context to achieve their desired autonomy (Eccles, Early, Frasier, Belansky, & McCarthy, 1997; Fuligni & Eccles, 1993; Fuligni, Eccles, Barber & Clements, 2001). The mismatch between parents' and adolescents' views of autonomy may be particularly disruptive. The work of Eccles and her colleagues (Eccles et al., 1993; Flangan, 1986, 1989; Lord, Eccles, & McCarthy, 1994; Yee, 1987) demonstrates the perceived parental control in the family was systematically related to the pattern of changes in early adolescents' self-esteem and academic motivation. Gutman

and Eccles (2007) documented that negative interaction with parents in seventh grade was associated with depression and low self-esteem 5 years later when these young people were at 11<sup>th</sup> grade. In addition to parenting practice, adolescents' conflict with parents is heightened (Smetana, 1989; Steinberg, 1990; Steinberg, Elmen, & Mounts, 1989). High levels of parent-adolescent conflict are linked to increase levels of problem behavior, substance use, and school failure (Galambos & Ehrenberg, 1997). Yet a low-hassle and high-support family environment helped early adolescents to better prepare for class across the school transition (Seidman, Lambert, Allen, & Aber, 2003).

Clearly, the transformation of adolescents and their family during middle school has explicit implication for understanding adolescents' substance use behaviors. Evidence from substance use and education literature, suggests certain characteristics of adolescents' family environment in the developmental transition intensify the odds that adolescents will initiate health compromising behaviors. In particular, the negative parent-child relationship, authoritarian parenting style and high level of family conflict are the candidates of risk factors that can exacerbate adolescents' odds of engaging substance use in the course of middle school, given their impact on constructing a positive, supporting family environment.

### Risk Factors in Peer Context

An additional transformation significant to substance use during early and middle adolescence is an increasing peer orientation. Peers are a critical component in adolescents' social world. In addition to spending more time with friends, early adolescents become more concerned about peer acceptance and popularity. Their susceptibility to peer influence increases as they begin transition into adolescence, and they begin to turn to friends more

often for support and guidance (Berndt, 1979; Steinberg & Monahan, 2007). Literature indicates that peer influence is a significant predictor of adolescent smoking (e.g., Conrad, Flay, & Hill, 1992; Ennett & Bauman, 1993; Hoffman, Sussman, Unger & Valente, 2006; Kobus, 2003; Tyas & Pederson, 1998), and document that adolescent friends share similarities in their drinking behaviors (e.g., Dishion, Capaldi, Spracklen, & Li, 1995; Duncan, Duncan, Strycker, 2006; Hamm, 2000). Finally, the opportunities to engage in such behaviors increase as parents reduce their monitoring and adolescents spend less time at home (Windle et al., 2008).

When children advance to middle school, their familiar peer networks are more likely to be disrupted due to school transition (Eccles et al., 1993; Hardy, Bukowski, & Sippola, 2002), yet establishing and maintaining a peer network in a new environment can be critical to receive companionship, advice, support or information from friends<sup>2</sup> in times of need (e.g., Rubin et al., 1998). Some empirical evidence shows that children with a greater number of mutual friends tend to be well adjusted in school (Gest, Graham-Bermann, & Hartup, 2001) and adolescents who are isolated in social networks are more likely to report substance use (Ennett et al., 2006). Even though there is still debate in literature on the number of friends that is optimal for promoting healthy development (Savin-Williams & Berndt, 1990), the number of friends may be used as a proxy to indicate how well early adolescents establish their peer network to help them navigating their new school environment. The developmental implication of considering this aspect is that an adolescent who had no friends will have difficult time adjusting to the new environment, which may lead to health compromising behaviors. Moreover, considering that substance use is commonly understood as a peer group phenomenon (Ennett et al., 2006), particular features of peer social networks are found to be

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<sup>2</sup> Peers and friends are used interchangeably in the text.

associated with substance use. Pearson and Michell (2000) recognized that adolescents who were most peripheral in the network tended to smoke, although this finding is not replicated in Ennett et al. (2006). In comprehensive studies of peer social network features and substance use, Ennett and her colleagues (e.g., Ennett et al., 2006; Ennett, Foshee, et al., 2008) revealed when adolescents oriented away from their school networks and nominated more friends from out-of-school networks than from school networks, they were more likely to use illicit substances. When they were isolated from the social network system, they had higher odds to report recent smoking. This out-of-school-network nomination was the most consistent predictor in the study, especially for early adolescents (i.e., ages 11 – 13). Evidently, adolescents whose social network affiliations are characterized by such aspects are exposed to greater risks than their counterparts whose peer group is not.

As early adolescents affiliate with certain peer groups, their resistance to peer influence is especially tenuous (Steinberg & Monahan, 2007). The connection between the structural aspects of peer groups and adolescents' substance use behaviors implies the greater vulnerability of and inclination to substance use when an individual is exposed to certain social networks. Such vulnerability might be amplified by negative middle school adjustment experience. Inclusion of characteristics of peer context in the multiple-risk model such as peer orientation toward out-of-school network or the number of friends brings necessary attention to risk factors in early adolescents' social world.

In sum, adolescents' relationships with their family undergo a stressful period during early and middle adolescence, and the influence of peer groups on individuals is augmenting (Rubin et al., 1998). These changes become particularly salient to young people at the point of transitioning to early adolescence and beyond. Transformations in family and peer groups,

along with the impersonal middle school environment, may pose immediate challenges for early adolescents' successful adaptation to middle school years. Application of the multiple-risk model to examine the risk factors in family, peer and school contexts make it possible to study multiple contexts simultaneously. With a summary set of risk factors, subgroups of adolescents can be classified (e.g., high risk group vs. low risk group) and their unique developmental trajectories of substance use can be explored. This approach provides a means to directly assess multiple risks in a parsimonious way. It also helps to answer the question of whether or not students who experienced more risks had a higher propensity of engaging substance use, and elucidate if the occurrence of substance involvement was a function of the number of risk factors experienced at the beginning of middle school. Such approach is relevant to both empirical understanding of early adolescent substance use during the developmental transition period and to the design of effective intervention, as it takes the variability of developmental pathways as a function of the youth's social contexts into consideration. Thus, for clarity in the examination on the relation between the risks at the beginning of middle school and adolescents' substance use behaviors, it is necessary to investigate the probability of engaging in substance use by risk-group status among adolescents who had not used substance in sixth grade. Whether or not the risk-group status is associated with occurrence of substance involvement over time will be explored as well.

### Summary

Moving into middle school possesses many meanings. It roughly corresponds to the beginning of the puberty and involves a major school-related transition. The middle school period is characterized as a developmental transition period with an embedded ecological

transition. The confluence of individual development changes and school social context generates developmental difficulties for some early adolescents. As an alternative means of negotiating new environment, the propensity of engaging in substance use might be increased. In addition to individual characteristics, school context, family environment and peer networks are key factors that affect adolescents' substance use. Each of these contexts is undergoing transformation at the middle school period, posing unique challenges for early adolescents' successful adaptation. Adjustments to these contexts comprise the middle school life experience of early adolescents. Compared to the knowledge about how the middle school transition affects academic functioning concurrently and longitudinally, however, there is less known about the implications of the middle school years as a whole on substance use. It is critical for research to examine how adolescents' middle school adjustments and experiences, as a result of joint effects of school, family and peers, influence substance use in middle school years<sup>3</sup>.

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<sup>3</sup> Although racial/ethnic differences are observed in a variety of substance use indicators in some national samples (e.g., YRBS, Monitoring the Future), preliminary analysis indicated that racial/ethnic difference was not significant in this sample. Research that used this sample usually just controlled them instead of including them as predictors (see Ennett et al., 2006; Ennett, Foshee, et al., 2008).

## CHAPTER 3 STUDY QUESTIONS

### Study Purpose

The purpose of the study was to examine to what extent adjustment, measured by school connectedness and school disengagement, during the first-year of middle school (i.e., sixth grade), and overall middle school adjustment, are associated with cigarette/alcohol use at the end of middle school (i.e., eighth grade). In particular, the study examined:

- a. the extent to which adjustment in middle school associated with cigarette and alcohol use concurrently and longitudinally for individual adolescents;
- b. the extent to which high risk of problematic adjustment in middle school associated with cigarette and alcohol use longitudinally with regard to risk groups that are classified based on social contexts. It attempted to investigate risk factors that are salient to the middle school period by moving beyond the influence of well-known risk factors in family and peer contexts.

### Research Questions and Hypotheses

To achieve the study purpose, the following research questions are specifically addressed.

#### *Research Question One*

Does middle school adjustment at the transition year (i.e., sixth grade), indicated by school connectedness and school disengagement, associate with cigarette and alcohol use concurrently?

Eccles et al. (1993, 1996) reported that perceived negative perceptions of school context were linked to declined self-esteem and academic functioning. It was posited that similar effect may be observed in relation to cigarette and alcohol use in the first year of middle school.

*Hypothesis one.* Cigarette and alcohol use will concurrently positively associate with negative school adjustment, indicated by lack of school connectedness and school disengagement during the transition year (i.e., sixth grade), after controlling for demographic variables and parental and peer influence on substance use.

In addition to controlling for demographic background, parent education was controlled as a proxy indicator of socioeconomic status. Also research data suggest that youth living in one-parent households are at significantly greater risk for alcohol, tobacco, and drug use ((Blum et al., 2000; Barrett, & Turner, 2006; Oman, Vesely, Tolma & Aspy, 2007). Therefore family structure was included in control variables to partial out its potential influence on adolescent substance use behaviors. Parent education and family structure are routinely controlled in the studies used the same master data set (e.g., Ennett et al., 2006; Ennett, Foshee et al., 2008).

#### *Research Question Two*

Does middle school adjustment in the first year of middle school (i.e., sixth grade), indicated by school connectedness and school disengagement, associate with cigarette and alcohol use at the end of eighth grade?



A body of research (e.g., Eccles, Lord et al., 1997; Seidman & French, 2004) demonstrates that the long lasting negative effect of the middle school adjustments and experiences extended to high school years. Some of negative outcomes include, not limited to, school failure, antisocial peer orientation, and delinquent behaviors. Estell et al. (2007) found negative middle school adjustment was associated with increase in substance use in high school. It was expected to observe a similar tendency that the negative middle school adjustments would lead to a positive association with substance use at the end of eighth grade.

*Hypothesis two.* Cigarette and alcohol use at the end of eighth grade will positively associate with negative school adjustment in sixth grade (indicated by lack of school connectedness and school disengagement) after controlling for demographic variables and parental and peer influence on substance use.

### *Research Question Three*

How do the trajectories of cigarette and alcohol use develop over time from the first year of middle school (sixth grade) to the end of eighth grade with respect to sense of school belonging and disengagement across the middle school years?

Adjustment to middle school is a continuous process. There is evidence indicating that negative changes, such as lower self-esteem, and lower grades, which are typically observed in the transition to middle school, are observed as well during the transition from sixth grade to seventh grade, and to lesser extent, also present at the transition from seventh grade to eighth grade (e.g., Barber & Olsen, 2004). In addition students' perception of school connectedness diminishes significantly across the school year during the middle grades (Anderman, 2003; Hamm & Faircloth, 2005). The dynamic nature of middle school

adaptation was taken into consideration by modeling the middle school adjustment as time-variant variables in growth curve analysis. It was expected that sense of school connectedness and school disengagement would predict the developmental trajectories of cigarette/alcohol involvement from sixth grade to eighth grade.

*Hypothesis three.* Students who felt less connected with school or less engaged in schoolwork throughout the middle school years will be on average more likely to be involved in substance use over the course of middle school.

#### *Research Question Four*

What is the probability of transitioning from non-substance user to substance user from sixth grade to the end of seventh grade with regard to risk-group status?

This investigation examined the likelihood of evolving into a substance user when adolescents had exposed to multiple risks in school, family and peer contexts at the beginning of middle school, comparing with those who had fewer risks. Previous studies demonstrate that early adolescents who felt most challenged and encountered more adjustment issues in the first year of middle school were often those who experienced academic struggling, behavior problems or family hassles in one or more domains at the same time (e.g., Estell et al., 2007; Roeser et al., 1998, 1999, 2000; Seidman & French, 2004). Given the influence of the transition year adjustment, it was posited that youth who were exposed to multiple contextual risks were more likely to initiate substance use than their counterpart who had no or fewer risks.

In the present study, each student was characterized based on school risks (i.e., lack of school connectedness, school disengagement), family risks (i.e., the parent-child relation, parenting style, and family conflict), and peer risks (i.e., the number of friends nominated,

out-of-school-social-network orientation). Then a risk score was summed across all of the risk factors and given to each student. The higher the score was, the more vulnerable the student was. High and low risk groups were then classified based on the risk factor scores.

*Hypothesis four.* After controlling for demography, parent education, family structure, parental and peer influence on substance use, early adolescents in the high-risk group who did not engage in substance use in sixth grade will be more likely to evolve into substance user at the end of seventh grade.

#### *Research Question Five*

Is it faster for early adolescents who were in the high-risk group than those who were in the low-risk group to initiate substance use after exposure to risk factors in sixth grade?

Research interest centers around the effects of the risks on substance use onset. Literature on risk studies supports the notion that the number of risk factors affects negative outcomes (Kraemer et al., 2001; Rutter, 1979; Sameroff & Fiese, 2000). By applying the multiple-risk model, it is possible to evaluate whether and when adolescents with different number of risk factors would initiate substance use. This analysis provided information about the timing of substance use onset and its associated risks, illuminating when and under what circumstance early adolescents are at greater risk of initiation.

*Hypothesis five.* After controlling for demography, parent education, family structure, parental and peer influence on substance use, adolescents who were in the high-risk group (i.e., exposed to more risks than those in the low-risk group during the transition year) will initiate substance use in less time (i.e., earlier) than the adolescents who were in the low-risk group during the middle school years.

## CHAPTER 4 METHODS

### Study Design

The present study was a secondary analysis of data collected by the *Context and Linkages Studies* from Spring 2002 to Spring 2005, which were conducted in Moore, Person, and Vance Counties, North Carolina. The study was funded by the National Institute on Drug Abuse (R01 DA13459). The Context's multiple data collection waves ideally suit the present study's aims.

### *Institutional Review Board Approval and Participant Consent*

The present study was exempted from Institutional Review Board (IRB) review because it was a secondary analysis of Context Study data, and all Context protocols were approved by the UNC-CH Public Health IRB and the Wake Forest University School of Medicine IRB. A Determination of IRB Approval (waiver) was submitted to the UNC-CH Public Health-Nursing IRB.

For the Context Study, a waiver of written parental consent was approved. Parents were notified about the study by letter (first class postage mailed and sent home with the child) each academic year and could refuse their child's participation by returning a postage-paid signed form or by calling a toll-free number. Students enrolling mid-year were consented for the spring data collection. Adolescents provided written assent for participation at each wave of data collection.

### *Adolescent Sample and School-based Data Collection*

The Context study was conducted in three North Carolina rural counties. All public schools with grades 6 – 12 were included in the study (i.e., middle schools, high schools, K-8, and alternative schools). There were seven waves of data collection. At Wave 1, adolescents were in grades 6, 7, and 8 in 13 schools. At Wave 7 they were in grades 10, 11, and 12. New students were able to enter the study at each wave, which explains the variation in eligible students from Wave 1 to Wave 5 (5906 to 6161). At each wave, all adolescents at the grade levels targeted except for those in self-contained classrooms for Exceptional Children (EC) and those with insufficient English language reading skills to complete the questionnaire in English were eligible for the study. The racial background of students at Wave 1 included: 56% White, 37% Black, 1% Hispanic, and 6% other. The overall response rates from Wave 1 to Wave 5 were 88.4%, 81.3%, 80.9%, 79.1% and 76% respectively.

School-based data collection was scheduled in advance and at least one make up day for absentee students was scheduled each wave at each school. Trained data collectors followed a written protocol for describing the study, obtaining assent, and giving instructions for completing the adolescent questionnaires. Adolescents completed the self-administered questionnaire in classrooms or larger group settings (e.g., cafeteria) in approximately one hour.

### **Study Sample**

The present study used the Context data from Wave 1 (sixth grade) to Wave 5 (eighth grade) and excluded students from K-8 and alternative schools. The exact size of the adolescent samples depended, in part, the specific research questions and the strategy used to

address missing data (see Analysis Plan Section). Following is a description of the study sample without addressing missing data.

Eligible adolescents include those who were in sixth grade at Wave 1 (N= 1769). Among them, there were 50.2% male and 49.8% female. Ethnic composition in this subsample was as follows: 49.4% White, 38.9% Black, and 10.2% other race<sup>4</sup>.

### Study Measures

Measures included adolescent cigarette/alcohol use, indicators of middle school transition adjustment, risk factors in family and peer contexts suggested by the literature, and demographic control variables. The cigarette/alcohol use and the adjustments were collected at all five waves to allow construction of time-varying variables. All of measures including parent measures were based on adolescents' self-report. Cronbach's alphas reported with the measures were averaged across five waves.

#### *Outcome measures*

*Cigarette use* measured adolescent lifetime smoking. At each wave students were asked whether or not they have ever smoked cigarette and the quantity that they had used. Because responses were skewed toward never and infrequent use, a binary variable was created to indicate whether or not a student had any use in their life time. Because this is a lifetime use measure, at the point a respondent first answered YES to this question during five data collection times, this indicated the approximate initiation time of cigarette use by the respondent. For instance, Respondent A answered NO to this question at Wave 1 and Wave 2, but YES at Wave 3. That means that the respondent started using cigarette at some time between Wave 2 and Wave 3. Therefore the measure at Wave 3 became the indicator of

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<sup>4</sup> These percentages are subject to rounding errors.

cigarette use initiation. This is relevant when the risk-group analysis (research question 4) and the survival analysis (research question 5) were conducted.

*Alcohol use* measured adolescent lifetime alcohol use. At each wave students were asked whether or not they have ever consumed alcohol and the quantity that they had used. Because responses were skewed toward never and infrequent use, a binary variable was created to indicate whether or not a student had any use in their life time. Like the measure cigarette use, this measure became the indicator of alcohol initiation when a respondent first answered YES to this question at a given point during five data collection times.

#### *Middle School Adjustment*

This measure included two scales, one addressed students' perceptions of their affective relationships with school and the other served as behavioral indicator.

*Sense of school connectedness* contained three items adopted from Roberts, Hom and Battistich (1995), assessing students' sense of school connectedness ( $\alpha = .84$ ). Students rated their agreement on a scale of 0 (strongly disagree) to 4 (strongly agree) on each item. These items were averaged to create an overall score for each participant. Scores range from 0 to 4. Higher score indicated greater sense of school connectedness. Sample items included "Students treat each other with respect", "willing to help" "school like a family".

*School disengagement* contained three items adapted from Farrell, Kung, White and Valois (2000), which ask students to indicate on a scale of 0 (none) to 4 (10 times or more) in the past three months how many times they have skipped school, cheated on test and skipped classes respectively ( $\alpha = .71$ ). These items were averaged to create an overall score for each participant. Scores range from 0 to 4. Higher score indicated greater school disengagement behavior.

### *Control Variables*

*Race* was dummy coded and includes three categories: white (reference group), African American, and other race. *Gender* was a dummy variable that female was coded as reference group. *Parent education*, an indicator of family socioeconomic status, measured the highest education attained by mother and was coded as high school graduate or less versus more than high school graduate (reference group). *Family structure* was coded as two parents in the home (reference group) versus some other composition.

*Parent smoking* was a dichotomous variable that indicates whether or not the respondent's parent has ever smoked. Parents whose child answered YES to the question whether or not the parent has ever smoked were assigned 1; parents whose child answered NO to the question were assigned 0. *Parent drinking* was a dichotomous variable that indicates whether or not the respondent's parent has ever used alcohol. Parents whose child revealed that his/her parent has ever drunk alcohol were scored 1, if no they were scored 0. *Friend smoking* was a dichotomous variable that indicates whether or not the respondent's friends smoked cigarettes. It was created based on the question asking the number of friend who smoked cigarettes. Those who answered NONE of their friends smoked were assigned 0, the rest of adolescents whose answer was not NONE were assigned 1. *Friend drinking* was a dichotomous variable that indicates whether or not the respondent's friends have ever consumed alcohol. It was generated in the same way as the variable friend smoking.

### *Risk Score*

A cumulative risk score was used to assess to what extent adolescents were exposed to contextual risks in their life. Specifically, the continuous scores on each adversity condition was dichotomized into two groups to represent the presence (1) or absence (0) of



risk and then all dichotomized scores will be summed up to generate the risk score indicator. Seven conditions were identified as risk factors from school, family and peer contexts. They were described as follows.

*School context.* *Lack of school connectedness* was identified as a risk factor in relation to adjustment to middle school. Description of this variable was the same as school connectedness (see above). Students whose wave-1 score was one standard deviation below the mean were included in the risk group. They felt most disconnected from their school.

*School disengagement* was identified as a risk factor in relation to adjustment to middle school. See above for the description of this variable. Students whose wave-1 score was one standard deviation above the mean were assigned to the risk group. Similarly these students most frequently missed class, or school or cheated on a test than the rest of the students.

*Family environment.* Three scales described adolescent perception of their family environment. These scales have been widely used in substance use studies.

*Family conflict* was a continuous variable measured by an established scale (Bloom, 1985) to assess adolescent perception of family environment. Sample items included “fight a lot, throw things, sometime hit”. The Cronbach alpha for the scale at wave 1 was .83. Higher score showed more family conflicts. Adolescents whose wave-1 score was one standard deviation above the mean were placed in the risk category. *Parenting style* was a continuous variable consisting two established subscales which assess parental responsiveness and demandingness respectively (Jackson, Henrickson & Foshee, 1998) based on students’ self-report. Example of the responsiveness items included: “(Parent) tells me when I do a good job on things/makes me feel better when I am upset/wants to hear about my.” Example of the demandingness items included: “(Parent) has rules that I must follow/tells me times when I

must come home/makes sure I don't stay up too late.” Higher score indicates more authoritative parenting. The Cronbach alpha for the overall scale at wave 1 was .79.

Adolescents whose wave-1 score was one standard deviation below the mean were placed in the risk category. *Parent-child relation* was a continuous variable that evaluates the closeness between mother and the child. It consisted of 3 items, examples including “you feel close to her (the mother), (the mother) feels close to you”. Higher scores revealed adolescents’ perceptions of a closer relationship to parents. The Cronbach alpha for the scale was .79 at wave 1. Adolescents whose wave-1 score was one standard deviation below the mean were placed in the risk group.

*Peer context. The number of friends nominated* was determined by the number of friends who were nominated by the adolescent respondent. This variable was obtained through social network analysis by summing up the total friends who were nominated by the respondent. Social network analysis was conducted on friendships reported by adolescents at each wave of data collection. To obtain friendship nominations, each student was provided a Student Directory that included an alphabetical roster of students along with a unique four-digit peer identification number for each student. The directories included all enrolled students at the targeted grades in the school network; boundaries for the school networks depend on the nature of school. Networks in middle schools were bounded by grade within school; and in high schools, networks were bounded by school. Adolescents used the directory to identify up to five of their closest friends, starting with their best friend. Those who nominated friends one standard deviation below the mean number of friend nomination was placed in the risk group. *Out-of-school friend nomination* was determined by the mean number of out-of-school friend nomination. This variable was obtained through social

network analysis. It was similar to the variable described in Ennett et al. (2006) and Ennett, Foshee, et al. (2008) using the same master data set. During the friend-nomination process, if friends not in the school directory were nominated, then they were assigned identification number “0000.” Those who nominated friends from out-of-school network one standard deviation above the mean were placed in the risk group.

#### *Risk Group Indicator*

This variable was created based on individual risk score. Adolescents whose risk score was one standard deviation above the mean were placed in high- risk group. The rest of them were in low-risk group (Gutman et al., 2003).

#### *Analysis Plan*

The present study took a model-based inference approach. This approach means that a probability model is postulated aiming at inference to some large population (Sarndal, Swensson & Wretman, 1991; Snijders, 1999). That is to say, conclusion is applied not only to the investigated research population but to a wider population. Residuals in such probability models can be regarded as the result of non-included explanatory variables in analysis. They reflect the approximating nature of the model employed. The model-based inference will be adequate as long as the assumptions of the probability model reflect that certain effects are not explicitly included by observed variables in the model (Snijders, 1999).

#### *Preliminary Analyses*

Multiple statistical methods were used to test the proposed hypotheses. First, descriptive statistics were conducted to summarize basic relationships among variables (e.g., bivariate correlations) and screen data for distribution (e.g., skewness and kurtosis) and to report sample characteristics. Second, regression diagnostics were used to examine data for collinearity.

### *Missing Data*

The sample selected in the current study was students who were in the spring of sixth grade at Wave 1 data collection (N=1769). Then the sixth graders were followed through Wave 5 (the spring of eighth grade). It is ideal that all participants have scores for all variables at all time points thus a balanced longitudinal data set is achieved. Yet given that the Context study allowed eligible participants to enter or drop out at any data collection points, there was missing data at most of collection times. In addition, missing responses on questions about substance use tended to occur at higher grades. Taken together, missing data in the current study was not unusual, and gradually increased as data collection continues.

There are different ways handling missing data under various assumptions. First, the mechanisms behind missing data for this particular dataset were carefully examined. To assess the relation between missing cases and outcomes, two dummy variables were created to indicate missing cases in outcome variables (i.e., cigarette use and alcohol use) at each data collection point. For instance, a dummy variable of cigarette use at Wave 1 had two values, 1 equals missing case at Wave 1, 0 equals non-missing case at Wave 1. Then a series of t-test were conducted to test the group that did not report cigarette/alcohol use and the group that did report for a difference in mean of school connectedness and school

disengagement at each wave. Table 4.1 and Table 4.2 present the results from these analyses. As the results suggested, it appeared there was no difference in mean of school connectedness and school disengagement with regard to the groups that reported or did not report cigarette or alcohol use from sixth grade to eighth grade except that the two groups only differed at Wave 3 (the spring of seventh grade).

To further explore the relation between missing cases and non-missing cases, another two different dummy variables were created to represent missing cases in school connectedness and school disengagement at each data collection point. For example, a dummy variable of school connectedness at Wave 1 had two values, 1 equals missing case at Wave 1, 0 equals non-missing case at Wave 1. Given that both dependent variables and independent variables were not continuous variables (i.e., they were dummy variables), t-test was not appropriate. Then a series of  $\chi^2$  test were used to examine the association between the dummy variables of school connectedness/disengagement and outcome cigarette/alcohol use. A significant  $\chi^2$  value indicates a difference between the group that report school connectedness/disengagement and the group that did not report with respect to outcomes (i.e., cigarette/alcohol use). As Table 4.3 shows, the two groups (missing vs. non-missing in school connectedness) differed only in reporting cigarette use at Wave 1, 3 and 4. Close examination of missing cases in school connectedness revealed that the percentage of smokers among respondents who did not report school connectedness was not systematically high or low<sup>5</sup>. It seemed that missing school connectedness was not related to the value of cigarette use. Combining the results from t-test and  $\chi^2$  test, it appeared there was no systematic difference in missing on outcomes or on predictors.

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<sup>5</sup> The percentage of smokers in missing school connectedness from Wave 1 to Wave 5 was 40.38%, 37.21%, 49.28%, 56.98% and 48.75%; the percentage of non smokers was 59.62%, 62.79%, 50.72%, 43.02% and 51.25% respectively.

Similar procedures were repeated to test group difference in control variables such as demographic background, parent or friend substance use behaviors, parental education and family structure with respect to reporting cigarette/alcohol use. A series of  $\chi^2$  tests were performed because all of control variables were dichotomized and dependent variables were dummy variables indicating missing cases in cigarette use and alcohol use. A significant  $\chi^2$  value indicates a difference in control variables (e.g., parent education) between the group that report cigarette/alcohol use and the group that did not report. Examination of results (results were not shown here) signified that the respondents who did not report either of the outcomes were not different from the respondents who reported in terms of most of control variables except for three variables parent smoking, parent drinking and parental education. Compared to students who reported cigarette use, students who did not report had a higher percentage of parents who did not smoke (61.54% vs. 44.70%) or drink (40.82% vs. 27.03%) and a lower percentage of parents who ever smoked (38.46% vs. 55.30%) or drank (59.18% vs. 72.97% ), Compared to students who reported alcohol use, Students who did not report had a higher percentage of parents who only had high school degree or less (51.39% vs. 39.16%) and a lower percentage of parents who had more than high school degree (48.61% vs. 60.84%).

These analyses suggested there were no systematic differences on the fully observed variables between those with data present and those with missing data. That is to say, missing data in the sample did not depend upon outcome variables or any other particular variable. The data were observed to be a random sample. Subsequently a strong assumption can be made about missing mechanism, that is, the data are missing completely at random (MCAR) (Allison, 2002). Under a MCAR assumption, the reduced sample (i.e., excluding missing

cases from the data set) will be a random subsample of the original sample., This implies that the estimates for any parameter of interest will be unbiased for the listwise deleted data set given the estimates would be unbiased for the full data set (with no missing cases) (Allison, 2002). Therefore listwise deletion was adopted in the study to handle missing data by deleting from the sample any observations that have missing data on any variables in the model of interest. The advantage of this method is that it can be used for any kind of statistical modeling (Allison, 2002). For regression analysis, including logistic regression and Cox regression, listwise deletion is robust to produce consistent estimates of the slope coefficients and their standard errors (Allison, 2002). The disadvantage of this method is that the standard errors will generally be larger because less information is utilized (Allison, 2002).

Finally, a listwise deleted data had a minimal impact on growth curve modeling (GCM). A major advantage of GCM is that models can be estimated even when the data set is not perfectly balanced. Even if individuals vary in the number of time points to which they contributed data, analysis is still possible (Singer & Willet, 2003). For example, participants with only one wave of data can also contribute to the estimation of fixed effects where appropriate although they do not contribute to variance component estimation.

In sum, under MCAR, listwise deletion was used in the current study to handle missing data. Sub-data sets were individually created from the original data set for the purpose of testing each hypothesis of the two outcomes. Missing cases were listwise deleted from each sub-data set, hence sample sizes varied across the outcomes and the hypotheses testing. The sample size reported in the study reflected the actual sample size after listwise deletion. Even with listwise deletion, the smallest sample was 576. It was still sufficiently

large for its statistical method (here for the designated hypothesis testing method, logistic regression).

### *Hypotheses Testing*

To test the study's hypotheses, SAS 9.2 (SAS, 2002 - 2008) was used to perform analyses. Methods were described below regarding a series of hypotheses testing.

#### *Hypothesis One and Two*

Hypothesis 1 tested whether the middle school adjustments had any associations with substance use concurrently (i.e., in sixth grade), and hypothesis 2 tested the long-term associations between the sixth-grade adjustment and substance use in eighth grade. Given that the outcome measures were binary, logistic regression was appropriate to test the two hypotheses. Model building was straightforward for two outcomes. The predictors were the two adjustment indicators (i.e., school connectedness and school disengagement), controlling for race/ethnicity, gender, parent education, family structure, parent substance use and friend substance use.

#### *Hypothesis Three*

The goal of hypothesis 3 was to examine the trajectory of substance use with regard to individual adaptation to middle school. To test hypothesis 3, growth curve modeling was performed. Within multilevel or hierarchical linear models (HLM) framework, growth curve analysis is intended to examine within- and between-person change in substance use. It tests within-individual change over time at level one, thus each person's individual growth trajectory of self-report substance use behaviors and its shape can be described. At level two, between-individual differences in change are assessed in order to reveal heterogeneity across



individuals and to determine the relationships between level-2 predictors and level-1 each person's individual trajectory (Raudenbush & Bryk, 2002; Singer & Willett, 2003). These tests were performed in SAS GLIMMIX procedure.

*Building models.* Generally, when performing growth curve modeling, a sequence of models is tested. It begins with the unconditional means model (UMM). The goal of the UMM is to describe and partition variation in outcome across people without regard to time (Singer & Willett, 2003). Therefore it does not include any predictors. The UMM states that the change trajectory for all students is a straight line and that there is no change over time. If this model is rejected, then there is evidence indicating longitudinal change.

The next step is to test the unconditional growth model (UGM). The goal of the UGM is to examine average trajectory of change in the population over time, as well as the between-person variation in growth (Singer & Willett, 2003). It estimates the average within-person initial status and rate of change when time is the only predictor in the model. It is critical that either fixed effects or random effects are statistically significant in the UGM. Otherwise, it makes no sense to model growth when there is no growth observed in the data. Thus, the UGM should be tested as a precondition for further analyses.

When the UMM and UGM reveals that there is significant variability in the data, further model building takes place with additional predictor variables. This step is to establish theoretical models in which the effects of the substantive predictor variables of interest were tested. For the case at hand, to assess the trajectory of cigarette and alcohol use with regard to the middle school adjustments, indicators of the adjustments were entered as time-varying level-1 predictors. Level two predictors included gender, race/ethnicity, parent

education, family structure, parental substance use, friend substance use. Formulas are presented as follows.

Cigarette use:

Level-1 equation:

$$Y_{ij} = \beta_{0j} + \beta_{1j} \text{ wave}_{ij} + \beta_{2j} \text{ connectedness}_{ij} + \beta_{3j} \text{ disengagement}_{ij} + \varepsilon_{ij}$$

Level-1 equations:

$$\begin{aligned} \beta_{0j} = & \gamma_{00} + \gamma_{01} \text{ parents smoking}_j + \gamma_{02} \text{ friends smoking}_j + \gamma_{03} \text{ male}_j + \gamma_{04} \text{ black}_j + \gamma_{05} \text{ other}_j \\ & + \gamma_{06} \text{ parentedu}_j + \gamma_{07} \text{ familystructure}_j + \mu_{0j} \end{aligned}$$

$$\beta_{1j} = \gamma_{10} + \mu_{1j}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30}$$

Reduced form equation:

$$\begin{aligned} Y_{ij} = & \gamma_{00} + \gamma_{01} \text{ parents smoking}_j + \gamma_{02} \text{ friends smoking}_j + \gamma_{03} \text{ male}_j + \gamma_{04} \text{ black}_j + \gamma_{05} \text{ other}_j \\ & + \gamma_{06} \text{ parentedu}_j + \gamma_{07} \text{ familystructure}_j + \gamma_{10} \text{ wave}_{ij} + \gamma_{20} \text{ connectedness}_{ij} \\ & + \gamma_{30} \text{ disengagement}_{ij} + \varepsilon_{ij} + \mu_{0j} + \mu_{1j} \end{aligned}$$

Alcohol use:

Level-1 equation:

$$Y_{ij} = \beta_{0j} + \beta_{1j} \text{ wave}_{ij} + \beta_{2j} \text{ connectedness}_{ij} + \beta_{3j} \text{ disengagement}_{ij} + \varepsilon_{ij}$$

Level-1 equations:

$$\begin{aligned} \beta_{0j} = & \gamma_{00} + \gamma_{01} \text{ parentdrinking}_j + \gamma_{02} \text{ frienddrinking}_j + \gamma_{03} \text{ male}_j + \gamma_{04} \text{ black}_j + \gamma_{05} \text{ other}_j \\ & + \gamma_{06} \text{ parentedu}_j + \gamma_{07} \text{ familystructure}_j + \mu_{0j} \end{aligned}$$

$$\beta_{1j} = \gamma_{10} + \mu_{1j}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30}$$

Reduced form equation:

$$\begin{aligned} Y_{ij} = & \gamma_{00} + \gamma_{01}parentdrinking_j + \gamma_{02}frienddrinking_j + \gamma_{03}male_j + \gamma_{04}black_j + \gamma_{05}other_j \\ & + \gamma_{06}parentedu_j + \gamma_{07}familystructure_j + \gamma_{10}wave_{ij} + \gamma_{20}connectedness_{ij} \\ & + \gamma_{30}disengagement_{ij} + \varepsilon_{ij} + \mu_{0j} + \mu_{1j} \end{aligned}$$

*Comparing models.* After a series of models is conducted, the key becomes to identify the best fit model. If two models are nested<sup>6</sup>, they can be compared using the deviance statistic. If the difference in deviance between both models is statistically significant, the model with the smaller deviance should be preferred in that it fits the data better. A  $\chi^2$  test is used to test statistical significance with degrees of freedom equal to the number of independent constraints imposed. If two models are not nested, they can be compared with the Akaike information criterion (AIC) and the Bayesian information criterion (BIC). The smaller values are preferred (Singer & Willet, 2003). Since the outcome variables in the study were dichotomous, the GLIMMIX procedure provided three model fit indexes: pseudo-deviance, pseudo-AIC and pseudo-BIC. However, these indexes are not appropriate for comparing nested models.

*Centering variables.* It is essential that the variable under study have precise meaning so that statistical results can be related to the theoretical concerns that motivate the research (Raudenbush & Bryk, 2002). In the case of HLM (or GCM), the intercept and slopes in the level-1 model become outcome variables at level 2. It is vital that the meaning of these outcome variables be clearly understood. To facilitate interpretation, a common practice in

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<sup>6</sup> Two models are nested if one model can be obtained by constraining one or more parameters of the other model.

HLM application is to center predicting variables around grand mean. In the multilevel model for change, centering may take place of the predictor that represents time, of time-invariant predictors, and of time-varying predictors.

In the present study, the variable representing time was centered by subtracting a constant from each value for time. In the current data, time was initially represented by wave coded as a number from 1 to 5. In an analysis with this variable, the intercept would return estimates for students at Wave 0, which does not exist. In order for the intercept to be meaningful, time was recoded and 0 is assigned to Wave 1 (i.e., wave minus one), which is the beginning of the study. This new variable was then used as the predictor in the analyses. By centering time at the first time point, the intercept was interpreted as initial level for students at Wave 1 (i.e., sixth grade).

#### *Hypothesis Four*

Hypothesis 4 concerned which risk group was more likely to evolve from non-substance user to users within one year interval after adolescents exposed to a variety of contextual risks in sixth grade. Logistic regression was suitable to obtain predicted probabilities of becoming substance user for two risk groups. Model building was straightforward for two outcomes as well. The predictor was the risk group indicator, controlling for race, gender, parent education, family structure, parent substance use and friend substance use. The sample for this analysis was restricted to adolescents who had not yet used cigarette or alcohol at the first time of data collection (i.e., sixth grade. Non-cigarette users, N = 848; non-alcohol users, N = 576).

### *Hypothesis Five*

Hypothesis 5 tested the association between the risk factors experienced during the first year of middle school and initiation of substance use through the use of discrete-time proportional odds survival analysis (Allison, 1995; Singer and Willett, 2003). This type of model has several advantages that are well suited to testing the proposed hypotheses. First, survival models consider the timing as well as the occurrence (or nonoccurrence) of the first use of substance. Second, discrete-time survival analysis models right-censored data and properly accounts for the fact that many students will not initiate during the observation period. Third, it allows for the inclusion of time-dependent covariates and time-by-independent-variable interactions. Finally, the model allows for a discrete specification of time (Allison, 1995; Singer and Willett, 2003). In the current data, the initiation of substance use was measured at intervals (every 6 months) along a time scale; hence, it remained unknown about the precise time when initiation occurred. Rather, it was only definite that it occurred within a certain 6-month interval.

To obtain an overall depiction of the risk factors on substance initiation over the middle school years, the hazard rates were estimated for each of outcomes. The hazard rate indicates the instantaneous potential for substance use at each time point among those who have not yet initiated by that time point. It translates the length of time it takes for the event to occur into an expression of the speed with which it occurs. The model allows an assessment of the association between an independent variable and the hazard rate, when the other independent variables in the model are held constant, and of whether this association is statistically significant. A hazard ratio of 1 indicates that there is no relationship between the independent variable and the risk of substance use (Allison, 1995; Singer and Willett, 2003).

A hazard ratio less than 1 indicates that there is a decreased risk of substance use with the presence of the variable of interest and a hazard ratio of more than 1 indicates that there is an increased risk of substance use (Allison, 1995; Singer and Willett, 2003).

To help ensure that the effect of the risk factors is not spurious, the effect was assessed after adjusting for parent/friend substance use behaviors, parent education, and family structure. As well, the sample for this analysis was restricted to adolescents who had not used cigarette or alcohol at the first time of data collection (non-cigarette users,  $N = 959$ ; non-alcohol users,  $N = 669$ ).

Table 4.1

Analysis of Missing Data in Cigarette Use in Relation to School Connectedness and School Disengagement

Predictors	Missing cigarette use at each wave	N	Mean	t-test	<i>p</i>
School connectedness wave 1	No	1640	1.62	-1.47	0.14
	Yes	73	1.83		
School connectedness wave 2	No	1370	1.49	0.23	0.82
	Yes	65	1.46		
School connectedness wave 3	No	1306	1.24	-2.47	0.01
	Yes	48	1.64		
School connectedness wave 4	No	1158	1.42	0.88	0.38
	Yes	48	1.27		
School connectedness wave 5	No	1071	1.38	0.99	0.32
	Yes	44	1.20		
School disengagement wave 1	No	1661	0.18	-1.28	0.20
	Yes	72	0.24		
School disengagement wave 2	No	1388	0.22	-1.40	0.16
	Yes	63	0.31		
School disengagement wave 3	No	1325	0.37	-0.43	0.67
	Yes	50	0.41		
School disengagement wave 4	No	1177	0.35	-0.62	0.54
	Yes	53	0.41		
School disengagement wave 5	No	1089	0.41	-0.31	0.75
	Yes	50	0.44		

*Note.* Wave 1 was the spring of sixth grade; Wave 2 was the fall of seventh grade; Wave 3 was the spring of seventh grade; Wave 4 was the fall of eighth grade; and Wave 5 was the spring of eighth grade.

Table 4.2

Analysis of Missing Data in Alcohol Use in Relation to School Connectedness and School Disengagement

Predictors	Missing alcohol use at each wave	N	Mean	t-test	<i>p</i>
School connectedness wave 1	No	1642	1.63		
	Yes	71	1.59	0.30	0.76
School connectedness wave 2	No	1362	1.50		
	Yes	73	1.46	0.26	0.80
School connectedness wave 3	No	1306	1.24		
	Yes	48	1.69	-2.78	0.01
School connectedness wave 4	No	1156	1.41		
	Yes	50	1.52	-0.67	0.50
School connectedness wave 5	No	1073	1.38		
	Yes	42	1.13	1.31	0.19
School disengagement wave 1	No	1663	0.18		
	Yes	70	0.19	-0.15	0.88
School disengagement wave 2	No	1376	0.22		
	Yes	75	0.27	-0.86	0.39
School disengagement wave 3	No	1327	0.37		
	Yes	48	0.40	-0.38	0.71
School disengagement wave 4	No	1179	0.35		
	Yes	51	0.35	0.06	0.96
School disengagement wave 5	No	1099	0.41		
	Yes	40	0.38	0.30	0.76

*Note.* Wave 1 was the spring of sixth grade; Wave 2 was the fall of seventh grade; Wave 3 was the spring of seventh grade; Wave 4 was the fall of eighth grade; and Wave 5 was the spring of eighth grade.



Table 4.3

Analysis of Missing Data in School Connectedness and School Disengagement in Relation to Cigarette/ Alcohol Use

Outcomes	School connectedness		School disengagement	
	$\chi^2$	$p$	$\chi^2$	$p$
Cigarette use wave 1	7.83	0.01	2.23	0.13
Cigarette use wave 2	0.30	0.58	0.08	0.78
Cigarette use wave 3	4.17	0.04	0.41	0.52
Cigarette use wave 4	11.05	0.001	0.66	0.42
Cigarette use wave 5	2.77	0.10	0.004	0.95
Alcohol use wave 1	1.39	0.24	1.27	0.26
Alcohol use wave 2	0.33	0.56	0.01	0.93
Alcohol use wave 3	2.18	0.14	1.30	0.25
Alcohol use wave 4	2.01	0.16	3.93	0.05
Alcohol use wave 5	0.03	0.85	1.79	0.18

*Note.* Wave 1 was the spring of sixth grade; Wave 2 was the fall of seventh grade; Wave 3 was the spring of seventh grade; Wave 4 was the fall of eighth grade; and Wave 5 was the spring of eighth grade.

## **CHAPTER 5 RESULTS**

### **Demographic Characteristics of the Sample**

Table 5.1 shows key demographic characteristics of the sample by ethnic groups. Almost half (49.2%) of adolescents were White. Adolescents in the three ethnic groups (i.e., White, Black and Other) were mostly (>90%) age 11 to age 13 in sixth grade, with a small percentage of adolescents older than age 14. Fewer Black (58.6%) adolescents lived in two-parent homes than White (80.7%) and Other race (75.4%) adolescents. More White adolescents had at least one parent who had more than a high school education (White 62.9% vs. Black 47.7%, Other 44.1%). Review of the data revealed that White adolescents reported a higher percentage of parent lifetime cigarette and alcohol use than other two groups.

Table 5.2 shows the distribution of outcome variables across five waves of data from the spring of sixth grade to the fall of eighth grade. In sixth grade, percentages of adolescents who smoked or drank were 24% and 39% respectively. By eighth grade, percentages increased to 40% and 56% respectively. Some percentages were slightly higher than for national samples of same age youth; such differences may be due to differences in measures and data collection (e.g., Johnston et al., 2009; Substance Abuse and Mental Health Services Administration, 2009). Review of the data indicated, that proportions of adolescents reporting cigarette use and alcohol use increased noticeably across grades from Wave 1 (sixth grade) to Wave 5 (eighth grade) (see Figure 5.1). This trend has been observed in other

national surveys as well (e.g., Johnston et al, 2009). Such increase was accompanied with an increase in age (Figure 5.2). The decrease at older ages (i.e., age 16 and 17) was due to the paucity of cases at these ages.

Table 5.3 shows the means and standard deviations for the predictor variables for the whole sample. It is notable that students' perception of school connectedness continued to decline since the spring of sixth grade (Wave 1). Perceived school connectedness reached its lowest point in the spring of seventh grade (Wave 3) and recovered somewhat in eighth grade, but never returned to the level of sixth grade. On the other hand, school disengagement behaviors persistently increased from sixth grade to eighth grade, although examination of the means indicates that the quantity of the behaviors remained small. With regard to patterns of usage among significant others, over half of parents had either smoked or used alcohol. Almost a quarter of adolescents' friends had ever smoked or used alcohol. Over one-third of parents had only a high school education or less; a quarter of adolescents lived in a single-parent family home.

## Hypotheses Testing

### *Hypothesis One*

Hypothesis one states that cigarette and alcohol use, indicated by lack of school connectedness and school disengagement, will concurrently positively associate with negative school adjustment during the transition year, after controlling for demographic variables and parental and peer influence on substance use. Given listwise deletion, the sample for the analysis was  $N = 1199$  (smoking) and  $N = 1121$  (drinking).

The results for two outcomes are presented in Table 5.4 and Table 5.5. Both odds ratio and  $\beta$ -estimate are included. The odds ratio is a relative measure of risk. It helps interpretation by subtracting 1.0 from the odds ratio and multiplying by 100. If the value obtained is positive, then for dichotomous independent variables, it tells how much more likely it is that someone who is in category A (e.g., female) under study will develop the outcome as compared to someone who is in reference group (e.g., male); for continuous independent variables, it tells how much on average someone will be more likely to develop the outcome. If the value obtained is negative, then it will be less likely to develop the outcome.

As Table 5.4 shows, after accounting for control variables, both indicators of the middle school adjustment—school connectedness and school disengagement in sixth grade—were strongly related to concurrent cigarette use. Early adolescents who felt more strongly connected to their school were on average 17% less likely to use cigarette (odds ratio [OR] = 0.83,  $p < .01$ ); participants who reported greater school disengagement behaviors were more likely to engage in cigarette use (OR = 4.89,  $p < .0001$ ).

A similar pattern occurred for the relationship between school belonging and alcohol use (see Table 5.5 ), such that students who were more strongly attached to their schools were on average 24% less likely to start drinking (OR = 0.76,  $p < .0001$ ). Further, the more students who disengaged from school work, the more likely they drank (OR = 2.52,  $p < .0001$ ).

Thus, as expected, the results supported hypothesis one. There was a significant association between early adolescents' middle school adjustment and concurrent cigarette/alcohol use. It appears that experiences during the transition year are associated not

only with academic motivation (e.g., Eccles et al., 1993) but also with adolescent health behaviors

### *Hypothesis Two*

Hypothesis two states that, that cigarette and alcohol use in sixth grade will positively associate with negative school adjustment, indicated by lack of school connectedness and school disengagement, at the end of eighth grade after controlling for demographic variables and parental and peer influence on substance use. Given listwise deletion, the sample for the analysis was  $N = 845$  (smoking) and  $N = 800$  (drinking).

Logistic regression results of smoking and drinking are presented in Table 5.6 and Table 5.7 respectively. After controlling for wave-1 self-smoking and wave-1 friends' smoking and other demographic variables (Table 5.6), there was an inverse relation between adolescents who perceived school environment positively in sixth grade and cigarette use in eighth grade. Every unit increase in positive perception of school connectedness in sixth grade was likely to reduce the odds of cigarette use by 17% in eighth grade ( $OR = .83, p < .01$ ). Yet contrary to expectation, adolescents' school disengagement behaviors in sixth grade appeared not to be associated with cigarette use in eighth grade. But adolescents whose friends smoked in sixth grade had higher odds of smoking in eighth grade ( $OR=1.78, p < .02$ ); adolescents whose parent ever smoked or had education less than high school were over 70% more likely to smoke in eighth grade ( $OR = 1.72, p < .01$ ;  $OR = 1.42, p < .05$ , respectively), which is consistent with previous findings (e.g., Kobus, 2003). As for alcohol use in eighth grade, school connectedness was approaching significance at .10 level ( $OR = .88, p = .08$ ); again adolescents' school disengagement behaviors in sixth grade were not longitudinally related to alcohol use in eighth grade.

Results partially supported hypothesis two. Longitudinally, there was a significant association between sixth-grade school connectedness—one of indicators of the middle school adjustments and eighth-grade cigarette/alcohol use. However, findings failed to support the association between school disengagement behavior and cigarette/alcohol use.

### *Hypothesis Three*

Hypothesis three states that students who felt less connected with school or less engaged in schoolwork throughout the middle school years will be on average more likely to be involved in substance use over the course of middle school. Given listwise deletion, the sample for the analysis was  $N = 1262$  (smoking) and  $N = 1184$  (drinking).

The results from the unconditional mean and linear growth models for the two outcomes are presented in Table 5.8 and 5.9 (i.e., Model A & Model B). For each substance use outcome, the level-1 fixed effects revealed that the intercept in sixth grade was significantly different than zero and that there was significant growth in substance use from Wave 1 (the spring of sixth grade) to Wave 5 (the spring of eighth grade) (indicated by the variable wave). In addition, the models indicated that there was significant individual variation in intercept. Although random effects of slope were not significant in the unconditional growth model, this did not necessarily signify that there was no variation around slope in the data. There may be underlying factors that need to be controlled to detect individual variability. Therefore the conditional models were continued with inclusion of level-2 predictors.

The level-2 demographic variables, parent education, family structure, and parent and friend substance use behaviors, were included to assess their impact on adolescent cigarette and alcohol use at the initial status point. As Model C (see Table 5.8 & 5.9) shows, in the

conditional models, both level-2 random effects (intercept and slope) were significant, suggesting individual variations around initial status (intercept) and rate of change (slope). In addition, as expected, parent and friend substance use behaviors had substantial influence on adolescent cigarette and alcohol use. This has been documented by past research that parent and friend substance use behaviors are reliable predictors of adolescent use (e.g., Avenevoli & Merikangas, 2003; Kobus, 2003). The level-2 variables were also tested for their impact on rates of change, and the interaction of gender with time was included in the model. T-test analysis revealed that the interaction was not statistically significant, indicating the slopes of the two substance outcomes were the same for boys and girls. The same procedure was repeated for race, parent education, family structure, and parent and friend substance use behaviors, with similar results obtained. Hence, none of the interaction terms was included in Model C.

The relationships between substance use and measures of adolescents' middle school adjustment above and beyond demographic and other controls are shown in Model D (Table 5.8 and Table 5.9). Where main effects were significant, the findings suggested, as hypothesized, that the middle school adjustment experiences were strongly associated with two substance use behaviors. Adolescents' sense of school connectedness appeared to mitigate the likelihood of using cigarette in the middle school years on average by 17% (OR = .83,  $p < .0001$ ). When they disengaged from schoolwork quite often, they were twice as likely to be at risk of smoking (OR = 4.76,  $p < .0001$ ).

Similar patterns were evident for alcohol use. Students' sense of school connectedness across the middle school period was highly predictive of alcohol use (OR = .73,  $p < .0001$ ). In other words, experiencing strong connections with school significantly

reduced the risk of using alcohol in the middle school years. In addition, the more disengaged from school during the transition year and throughout the middle school years, the more likely early adolescents engaged in alcohol use ( $OR = 2.28, p < .0001$ ) in middle school. The interactions of time and the school transition experiences were tested for the two substance outcomes respectively. The interaction between time and school disengagement was significant in the conditional growth model of cigarette use and included in the final Model D (Table 5.8). The estimate for this interaction term was negative, suggesting that the effect of school disengagement on cigarette use diminished as time elapsed. However, the interaction between school connectedness and time was not significant, therefore not included in the final model. Finally, the Glimmix procedure produced three model fit indexes: pseudo-Deviance, pseudo-AIC and pseudo-BIC scores. It is not suitable to use them to compare nested models.

In summary, results supported hypothesis three. Overall, there were significant associations between the school experience/adjustment variables and cigarette/alcohol use during the middle school years. It is interesting to note that in testing hypothesis two, the findings did not reveal an association between school disengagement behavior and cigarette/alcohol use. Yet their dynamic interplay was uncovered in growth curve analysis by tracking the school adjustments from sixth grade to eighth grade.

#### *Hypothesis Four*

Hypothesis four states that early adolescents at high risk for substance use, but who did not engage in substance use in sixth grade will be more likely to evolve into a substance user by the end of seventh grade. The sample for this analysis was restricted to adolescents who had not yet used cigarette or alcohol at the first time of data collection (i.e., sixth grade),



given listwise deletion, the final data set for analysis included 848 non-cigarette users and 576 non-alcohol users respectively.

Logistic regression results of cigarette use and alcohol use are presented in Table 5.10 and Table 5.11 respectively. After controlling for demographic background, parent education, family structure, and friends' and parent smoking behaviors in sixth grade (Wave 1), risk group status was approaching significant ( $OR = 1.59, p = .08$ ). Compared with the low-risk group, adolescents in the high-risk group were 59% more likely to start smoking at the end of seventh grade, given the fact that they did not engage in cigarette use behavior in sixth grade. In other words, early adolescents who were exposed to the number of risks that is one standard deviation above the mean had the higher propensity of initiating cigarette use. However, this pattern was not observed in the analysis of alcohol use. Risk group status was unable to differentiate adolescents with regard to their probability of initiating alcohol use at the end of seventh grade. The only significant factor in the model was parent drinking behavior ( $OR = 3.03, p < .0001$ ).

Results have partially supported hypothesis four in one of two substance use outcomes. There was a reliable association between risk-group membership and cigarette use initiation at the end of seventh grade among adolescents who did not smoke in sixth grade. The high-risk group tended to have higher odds of initiating cigarette use. Yet, risk-group membership was not associated with alcohol use initiation at the end of seventh grade.

#### *Hypothesis Five*

Hypothesis five states that adolescents in the high-risk group who experienced more risks during the first year of middle school, will initiate substance use earlier than will adolescents in the low-risk group who experienced fewer risks. The sample for this analysis

was restricted to adolescents who had not yet used cigarette or alcohol at the first time of data collection (i.e., sixth grade); given listwise deletion, the final data set for analysis included 959 non-cigarette users and 669 non-alcohol users respectively.

The results of survival analysis are summarized in Table 5.12 and Table 5.13 for two outcomes respectively. The hazard ratio indicates the effect of risk-group membership on initiation after adjusting for demographic background, parent education, family structure, peer substance use and parent substance use behaviors. A hazard ratio of 1 indicates that there is no relationship between the independent variable and the outcome; a hazard ratio less than 1 indicates that there is a decreased risk of substance use with the presence of the variable of interest and a hazard ratio of more than 1 indicates that there is an increased risk of substance use.

The results revealed that risk-group status was significantly associated with increased hazard of initiation of cigarette use (hazard ratio [HR] = 1.38,  $p < .05$ ). In other words, the hazard of cigarette use initiation for adolescents who were in the high-risk group was 38 % faster than those who were in the low-risk group. Other significant predictors in the model included friend smoking (after adjusting for all other variables, adolescents whose friend smoke had a higher hazard of initiation), parent smoking (parent smoking was associated with higher odds of initiation), parent education (lower parental education level was associated with higher odds of initiation), family structure (single-parent family was associated with higher odds of initiation). By contrast, risk-group status was not associated initiation of alcohol use. The only significant factor in the model was parent drinking behavior. Adolescents whose parents drank had a higher hazard rate than those whose parents did not drink (HR = 2.65,  $p < .001$ ).

To present these findings in a more intuitive way, the survival functions of cigarette use for the two risk groups were estimated (data not shown here) and the model-predicted survival probability curves of the risk groups were plotted. Controlling for the effects of all other variables (i.e., all control variables were set at their sample mean), Figure 5.3 illustrated the predicted survival probability of cigarette use initiation for the two risk groups over the course of 30 months (i.e., 6-month interval multiplying 5 waves). The two groups did not differ in initiation rate during the first 12 months. Beginning Wave 3 (the spring of seventh grade), however, the survival function curves bent below a straight line, and the two curves separated from each other farther and farther, suggesting that the high-risk group displayed a faster and deeper decreasing survival rate over time, compared with the low-risk group. That is to say, the faster the survival rate decreased, the quicker adolescents in the high-risk group initiated cigarette use.

To further clarify the relation between the number of risks and the probability of substance use initiation, additional analyses were performed by using risk scores in the survival models. Instead of using the dichotomous indicator of risk-group status, this approach included the continuous risk-score variable in the model, thus directly assessing the effect of the number of risks on adolescent substance use initiation. The advantage of this approach included less arbitrary reduction of information resulted from dichotomization of the risk groups. The sample size for this risk-score analysis was slightly different from the risk-group analysis due to listwise deletion (N=969 for non-cigarette users; N = 656 for non-alcohol users).

The results are presented in Table 5.14 and Table 5.15. Findings are similar to what was found in the risk group analysis. Again, risk score was a significant predictor in the

model of cigarette use initiation ( $HR = 1.13$ ,  $p < .01$ ). Given that risk score was a continuous variable (ranging from 0 to 7), a more helpful statistics was obtained by subtracting 1.0 from the HR and multiplying by 100. This calculation results in the estimated percent change in the hazard for each one-unit increase in the variable. Therefore, the risk score HR estimate indicated that for each one risk increase, the hazard of initiation went up by an estimated 15 percent. As was the case for the dichotomous risk-group status, risk score was not associated with adolescent alcohol use initiation.

In sum, the results from survival analysis supported hypothesis five for cigarette initiation only. The findings indicated that adolescents who were exposed to greater risk in the transition year of middle school tended to initiate cigarette use earlier than those who were experienced less.

Table 5.1

## Sample Characteristics in Sixth Grade by Ethnic Group

Variable	White* (N=870)		Black (N=686)		Other (N=179)	
	N	%	N	%	N	%
Gender						
Male	430	49.4	353	51.5	96	53.6
Female	440	50.6	333	48.5	83	46.4
Age						
11 or less	87	10.0	57	8.3	24	13.4
12	671	77.0	426	62.1	117	65.4
13	104	12.0	160	23.3	33	18.4
14	8	1.0	33	4.8	3	1.7
15 or more			10	1.5	2	1.1
Mean age	12		12.3		12.1	
Missing case N = 1						
Parent Education						
High school education or less	270	31.0	276	40.2	78	43.6
More than high school education	547	62.9	327	47.7	79	44.1
Missing case N = 165						
Family structure						
Two-parent	702	80.7	402	58.6	135	75.4
Other than two parent	155	17.8	249	36.3	43	24.0
Missing case N = 56						
Parent ever used cigarette						
Yes	444	51.0	248	36.2	59	33.0
No	271	31.1	260	37.9	86	48.0
Missing case N = 377						
Parent ever used alcohol						
Yes	550	63.2	282	41.1	90	50.3
No	131	15.1	181	26.2	38	21.2
Missing case N = 477						

\* Total N = 1769. There were 34 cases missing.

Table 5.2

Proportions of Lifetime Cigarette/Alcohol User, Standard Deviation across Five Time Points

Outcome	Proportion	SD	N
Lifetime Smoking			
Sixth grade, spring	0.24	0.43	1692
Seventh grade, fall	0.33	0.47	1413
Seventh grade, spring	0.38	0.48	1375
Eighth grade, fall	0.40	0.49	1244
Eighth grade, spring	0.40	0.49	1151
Lifetime Drinking			
Sixth grade, spring	0.39	0.49	1691
Seventh grade, fall	0.49	0.50	1396
Seventh grade, spring	0.53	0.50	1374
Eighth grade, fall	0.55	0.50	1244
Eighth grade, spring	0.56	0.50	1163

Table 5.3

Means and Standard Deviations for the Predictors and Control Variables of the Whole Sample.

Variable	Mean	SD	N	Range
<b>Predictors</b>				
<b>Middle School Adjustment</b>				
School Connectedness				
Sixth grade, spring	1.63	1.19	1713	0 - 4
Seventh grade, fall	1.49	1.16	1435	0 - 4
Seventh grade, spring	1.25	1.11	1354	0 - 4
Eighth grade, fall	1.41	1.14	1206	0 - 4
Eighth grade, spring	1.37	1.18	1115	0 - 4
School Disengagement				
Sixth grade, spring	0.18	0.39	1733	0 - 4
Seventh grade, fall	0.23	0.47	1451	0 - 4
Seventh grade, spring	0.37	0.65	1375	0 - 4
Eighth grade, fall	0.35	0.69	1230	0 - 4
Eighth grade, spring	0.41	0.72	1139	0 - 4
<b>Control Variables</b>				
<b>Demographics</b>				
Male	49.8%			
African American	38.9%			
Other race/ethnicity	10.2%			
Parent Education-high school or less	39.7%		1604	0 - 1
Single-parent family	26.5%		1713	0 - 1
Parent Smoking	54.7%		1392	0 - 1
Parent Drinking	72.4%		1292	0 - 1
Friend Smoking in sixth grade	15.5%		1736	0 - 1
Friend Drinking in sixth grade	12.9%		1750	0 - 1

Table 5.4

Logistic Regression Predicting Sixth Grade Concurrent Cigarette use.

Variable	$\beta$	SE	Odds Ratio
Intercept	2.89*****	0.24	
School connectedness	-0.19***	0.07	0.83
School disengagement	1.59*****	0.24	4.89
Control variables			
Friend smoking in sixth grade (reference: non-smoking)	1.57*****	0.19	4.80
Parent smoking (reference: non-smoking)	1.28*****	0.18	3.60
Ethnicity (reference: white)			
African American	0.25	0.17	1.29
Other	0.31	0.26	1.37
Male (reference: female)	0.59*****	0.16	1.80
Parent education - high school or less	0.29	0.16	1.33
(reference group: more than high school)			
Single-parent family (reference: two-parent family)	0.29	0.17	1.33

Note. N = 1199.

\*\*\*  $p < .01$ . \*\*\*\*\*  $p < .001$ , \*\*\*\*\*  $p < .0001$ .



Table 5.5

Logistic Regression Predicting Sixth Grade Concurrent Alcohol use.

Variable	$\beta$	SE	Odds Ratio
Intercept	1.76*****	0.25	
School connectedness	0.27*****	0.06	0.76
School disengagement	0.92*****	0.22	2.52
Control variables			
Friend drinking in sixth grade (reference: non-drinking)	1.50*****	0.22	4.47
Parent drinking (reference: non-drinking)	1.90*****	0.20	6.71
Ethnicity (reference: white)			
African American	-0.13	0.16	0.88
Other	-0.26	0.24	0.77
Male (reference: female)	0.29*	0.14	1.34
Parent education - high school or less	-0.05	0.14	0.95
(reference group: more than high school)			
Single-parent family (reference: two-parent family)	0.26	0.16	1.30

*Note.* N = 1121.\*  $p < .05$ . \*\*\*\*\*  $p < .0001$ .

Table 5.6

Logistic Regression Predicting Eighth Grade Cigarette Use.

Variable	$\beta$	SE	Odds Ratio
Intercept	0.90****	0.21	
School connectedness	-0.19***	0.07	0.83
School disengagement	0.01	0.22	1.01
Control variables			
Smoking in sixth grade (reference: non-smoking)	1.48****	0.21	4.40
Friend smoking in sixth grade (reference: non-smoking)	0.58**	0.24	1.78
Parent smoking (reference: non-smoking)	0.54***	0.16	1.72
Ethnicity (reference: white)			
African American	0.02	0.18	0.98
Other	0.25	0.27	1.28
Male (reference: female)	-0.20	0.16	0.82
Parent education - high school or less	0.35*	0.16	1.42
(reference group: more than high school)			
Single-parent family (reference: two-parent family)	0.23	0.19	1.26

*Note.* N = 845.\*  $p < .05$ . \*\*  $p < .02$ . \*\*\*  $p < .01$ . \*\*\*\*  $p < .001$ .

Table 5.7

Logistic Regression Predicting Eighth Grade Alcohol Use.

Variable	$\beta$	SE	Odds Ratio
Intercept	0.50*	0.25	
School connectedness	-0.13+	0.07	0.88
School disengagement	0.03	0.23	1.03
Control variables			
Drinking in sixth grade (reference: non-drinking)	1.30*****	0.19	3.66
Friend drinking in sixth grade (reference: non-drinking)	0.05	0.27	0.95
Parent drinking (reference: non-drinking)	1.14*****	0.19	3.12
Ethnicity (reference: white)			
African American	0.02	0.19	0.98
Other	0.17	0.29	0.84
Male (reference: female)	-0.51***	0.16	0.60
Parent education - high school or less	0.04	0.19	1.03
(reference group: more than high school)			
Single-parent family (reference: two-parent family)	0.03	0.17	1.04

Note. N = 800.

+  $p < .10$ . \* $p < .05$ . \*\*\*  $p < .01$ . \*\*\*\*\*  $p < .0001$ .

Table 5.8

Growth Curve Modeling for Cigarette Use from Sixth Grade to Eighth Grade.

Variable	Model A		Model B		Model C		Model D	
Fixed effects	OR		OR		OR		OR	
Intercept	-0.86*****	0.43	-1.41*****	0.25	-2.97*****	0.05	-2.87*****	0.06
Wave			0.30*****	1.35	0.32*****	1.38	0.28*****	1.32
Control variables								
Male (reference group: female)					0.17	1.18	0.11	1.12
Race (reference group: White)								
African American					0.35***	1.42	0.28*	1.33
Other					0.34	1.40	0.20	1.22
Parent education - high school or less (reference group: more than high school)					0.48*****	1.62	0.51*****	1.67
Single-parent family (reference: two-parent family)					0.43***	1.54	0.40	1.49
Parent smoking (reference: non-drinking)					1.30*****	3.66	1.26*****	3.51
Friend smoking (reference: non-drinking)					1.79*****	6.01	1.59*****	4.90
Middle school adjustment								
School connectedness							-0.19*****	0.83

Table 5.8

Growth Curve Modeling for Cigarette Use from Sixth Grade to Eighth Grade.

Variable	Model A		Model B		Model C		Model D	
School disengagement							1.56*****	4.76
Wave* School disengagement							-0.17***	0.84
Level 2 random effects	Variance component	SE	Variance component	SE	Variance component	SE	Variance component	SE
Intercept	3.04	0.20	3.39	0.25	2.36	0.22	2.36	0.23
Slope			0.01	0.02	0.10	0.03	0.06	0.03
Fit statistics								
Goodness of fit								
Pseudo-Deviance	22796.96		23108.06		23363.75		23752.97	
Pseudo-AIC	22800.96		23116.06		23385.75		23781.06	
Pseudo-BIC	22813.94		23142.03		23457.15		23871.83	

Note.  $N = 1262$ .

\*  $p \leq .05$ . \*\*\*  $p \leq .01$ . \*\*\*\*  $p \leq .001$ . \*\*\*\*\*  $p < .0001$ .

Table 5.9  
Growth Curve Modeling for Alcohol Use from Sixth Grade to Eighth Grade.

Variable	Model A		Model B		Model C		Model D	
Fixed effects	OR		OR		OR		OR	
Intercept	0.20*****	1.22	-0.19*****	0.83	-1.91*****	0.15	-1.40*****	0.25
Wave			0.23*****	1.26	0.25*****	1.28	0.18*****	1.20
Control variables								
Male (reference group: female)					0.01	0.99	0.05	0.96
Race (reference group: White)								
African American					-0.21***	0.81	-0.34	0.71
Other					0.04	0.97	-0.16	0.85
Parent education - high school or less (reference group: more than high school)					0.01	1.01	0.03	0.97
Single-parent family (reference: two-parent family)					0.24	1.27	0.20	1.22
Parent drinking (reference: non-drinking)					1.16*****	3.18	2.02*****	7.53
Friend drinking (reference: non-drinking)					2.08*****	7.98	0.99*****	2.69
Middle school adjustment								

Table 5.9  
Growth Curve Modeling for Alcohol Use from Sixth Grade to Eighth Grade.

Variable	Model A		Model B		Model C		Model D	
School connectedness							-0.32*****	0.73
School disengagement							0.82*****	2.28
Level 2 random effects	Variance component	SE	Variance component	SE	Variance component	SE	Variance component	SE
Intercept	2.60	0.18	2.63	0.21	1.87	0.17	1.73	0.18
Slope			0.03	0.02	0.07	0.02	0.05	0.02
Fit statistics								
Goodness of fit								
Pseudo-Deviance	20942.10		21078.01		21277.86		18581.20	
Pseudo-AIC	20946.10		21086.01		21299.86		18607.20	
Pseudo-BIC	20958.97		21111.74		21370.59		18688.79	

Note. N = 1184.

\*\*\*  $p \leq .01$ . \*\*\*\*\*  $p < .0001$ .

Table 5.10

Logistic Regression Predicting Seventh Grade Cigarette Use Regarding Risk-group Status.

Variable	$\beta$	SE	Odds Ratio
Intercept	-1.95****	0.18	
Risk group (reference: low-risk)	0.47+	0.27	1.59
Control variables			
Friend smoking in sixth grade (reference: non-smoking)	0.95****	0.27	2.59
Parent smoking (reference: non-smoking)	0.60****	0.18	1.82
Ethnicity (reference: white)			
African American	0.25	0.19	1.28
Other	0.19	0.29	1.21
Male (reference: female)	-0.22	0.17	0.80
Parent education - high school or less (reference group: more than high school)	0.57****	0.17	1.77
Single-parent family (reference: two-parent family)	0.38+	0.20	1.46

*Note.* N = 848.+  $p < .10$ . \*\*\*\*  $p < .001$ . \*\*\*\*\*  $p < .0001$ .



Table 5.11

Logistic Regression Predicting Seventh Grade Alcohol Use Regarding Risk-group Status.

Variable	$\beta$	SE	Odds Ratio
Intercept	-1.36*****	0.22	
Risk group (reference: low-risk)	0.32	0.33	1.38
Control variables			
Friend drinking in sixth grade (reference: non-drinking)	0.19	0.39	1.20
Parent drinking (reference: non-drinking)	1.11*****	0.20	3.03
Ethnicity (reference: white)			
African American	-0.25	0.21	0.78
Other	0.22	0.32	1.24
Male (reference: female)	0.06	0.19	0.94
Parent education - high school or less (reference group: more than high school)	0.005	0.19	1.01
Single-parent family (reference: two-parent family)	0.25	0.22	1.29

*Note.* N = 576.\*\*\*\*\*  $p < .0001$ .

Table 5.12

Survival Analysis Predicting Cigarette Use Initiation Regarding Risk-group Status.

Variable	$\beta$	SE	Hazard Ratio
Risk group (reference: low-risk)	0.33*	0.16	1.38
Control variables			
Friend smoking in sixth grade (reference: non-smoking)	0.73*****	0.15	2.07
Parent smoking (reference: non-smoking)	0.46*****	0.11	1.59
Ethnicity (reference: white)			
African American	0.20*	0.12	1.23
Other	0.27	0.18	1.31
Male (reference: female)	0.09	0.11	0.91
Parent education - high school or less (reference group: more than high school)	0.33***	0.11	1.39
Single-parent family (reference: two-parent family)	0.29**	0.12	1.34

*Note.* N = 959.\*  $p \leq .05$ . \*\*  $p < .02$ . \*\*\*  $p < .01$ . \*\*\*\*\*  $p < .0001$ .

Table 5.13

Survival Analysis Predicting Alcohol Use Initiation Regarding Risk-group Status.

Variable	$\beta$	SE	Hazard Ratio
Risk group (reference: low-risk)	0.14	0.19	1.15
Control variables			
Friend drinking in sixth grade (reference: non-drinking)	0.01	0.23	1.01
Parent drinking (reference: non-drinking)	0.97*****	0.12	2.65
Ethnicity (reference: white)			
African American	0.01	0.12	0.99
Other	0.16	0.18	1.18
Male (reference: female)	0.06	0.11	0.94
Parent education - high school or less (reference group: more than high school)	0.10	0.11	0.90
Single-parent family (reference: two-parent family)	0.13	0.13	1.14

*Note.* N = 669.\*\*\*\*\*  $p < .0001$ .

Table 5.14

Survival Analysis Predicting Cigarette Use Initiation with Regard to Risk score.

Variable	$\beta$	SE	Hazard Ratio
Risk score	0.12***	0.05	1.13
Control variables			
Friend smoking in sixth grade (reference: non-smoking)	0.70*****	0.16	2.01
Parent smoking (reference: non-smoking)	0.45*****	0.11	1.58
Ethnicity (reference: white)			
African American	0.19	0.12	1.21
Other	0.25	0.18	1.29
Male (reference: female)	0.10	0.11	0.91
Parent education - high school or less (reference group: more than high school)	0.31***	0.11	1.37
Single-parent family (reference: two-parent family)	0.29*	0.12	1.33

*Note.* N = 969.\*  $p < .05$ . \*\*\*  $p < .01$ . \*\*\*\*\*  $p < .0001$ .

Table 5.15

Survival Analysis Predicting Alcohol Use Initiation with Regard to Risk score.

Variable	B	SE	Hazard Ratio
Risk score	-0.01	0.05	0.99
Control variables			
Friend drinking in sixth grade (reference: non-drinking)	0.04	0.24	1.04
Parent drinking (reference: non-drinking)	0.98*****	0.12	2.66
Ethnicity (reference: white)			
African American	-0.001	0.12	1.00
Other	0.16	0.18	1.18
Male (reference: female)	-0.07	0.11	0.93
Parent education - high school or less (reference group: more than high school)	-0.09	0.11	0.91
Single-parent family (reference: two-parent family)	0.14	0.13	1.15

*Note.*  $N = 656$ .\*\*\*\*\*  $p < .0001$ .

Figure 5.1 Cigarette Use and Alcohol Use from Sixth Grade (Wave 1) to Eighth Grade (Wave 5) (%)

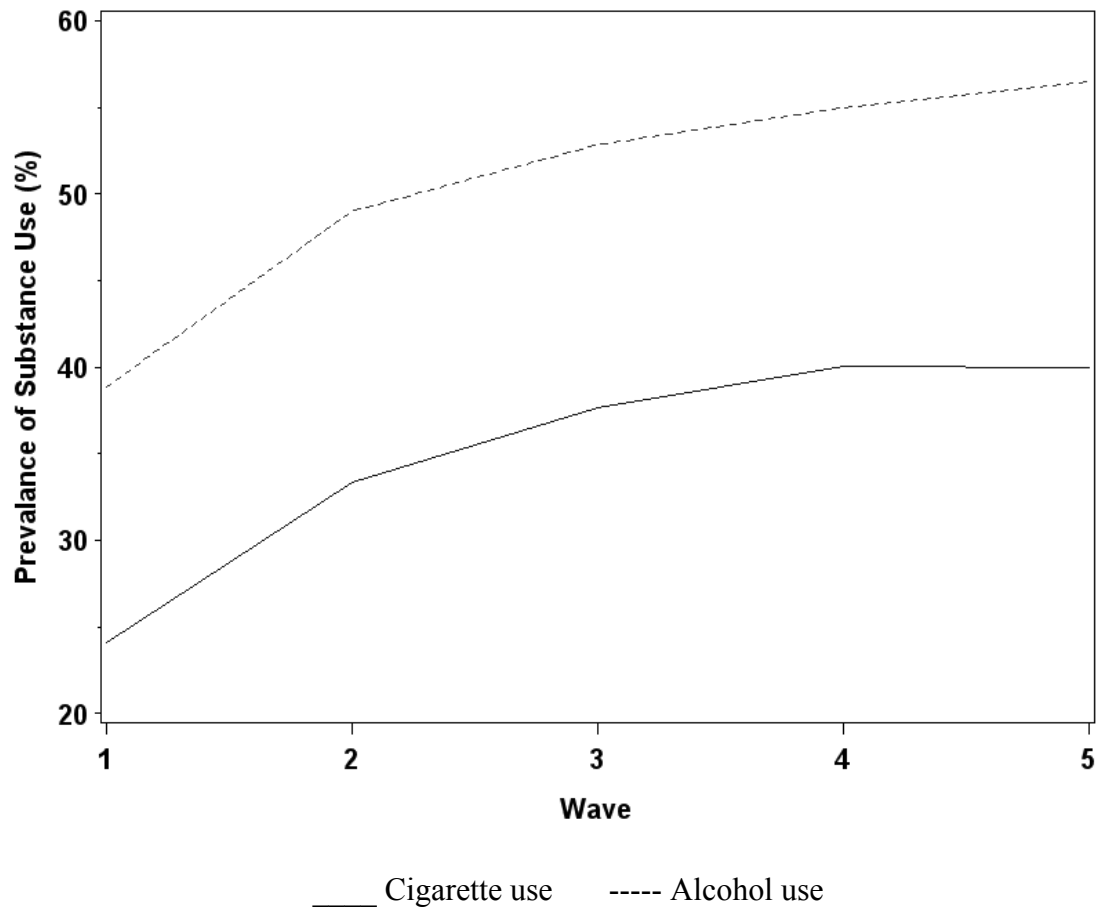


Figure 5.2

Cigarette Use and Alcohol Use across All Ages (%)

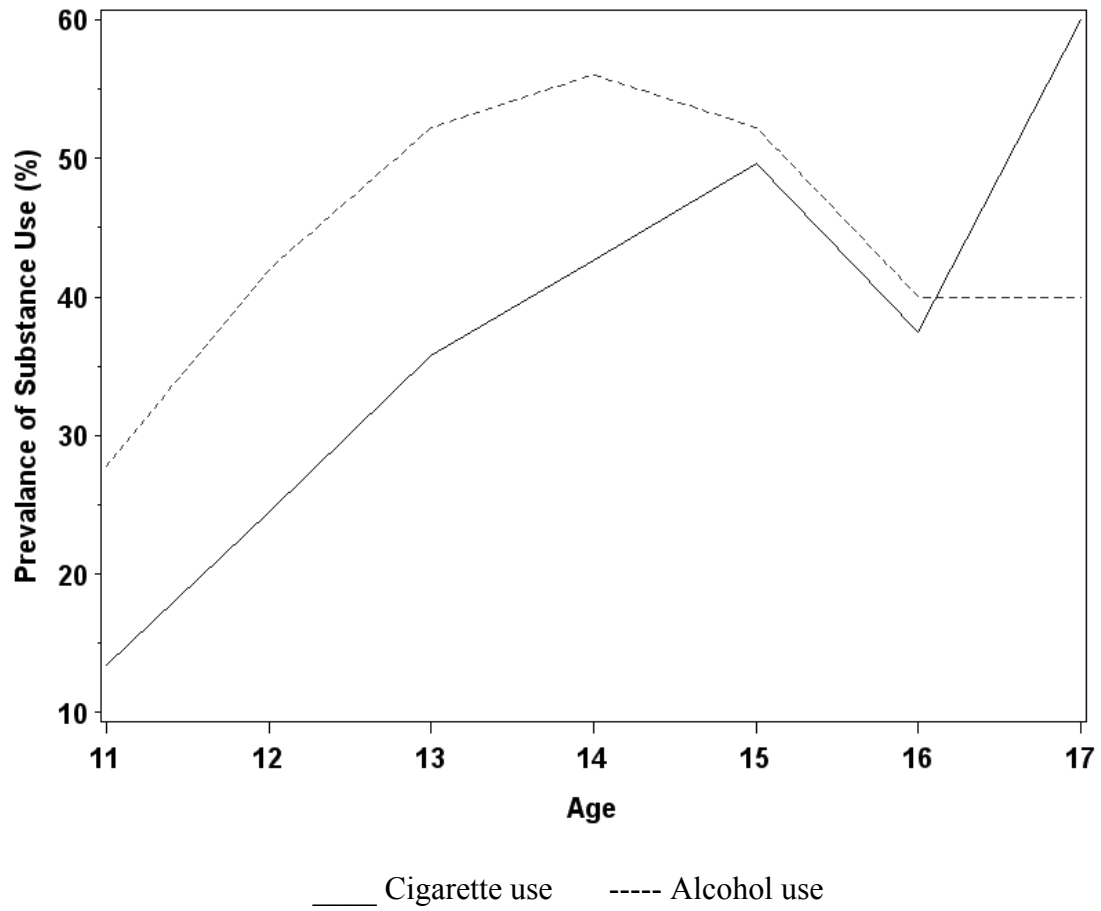
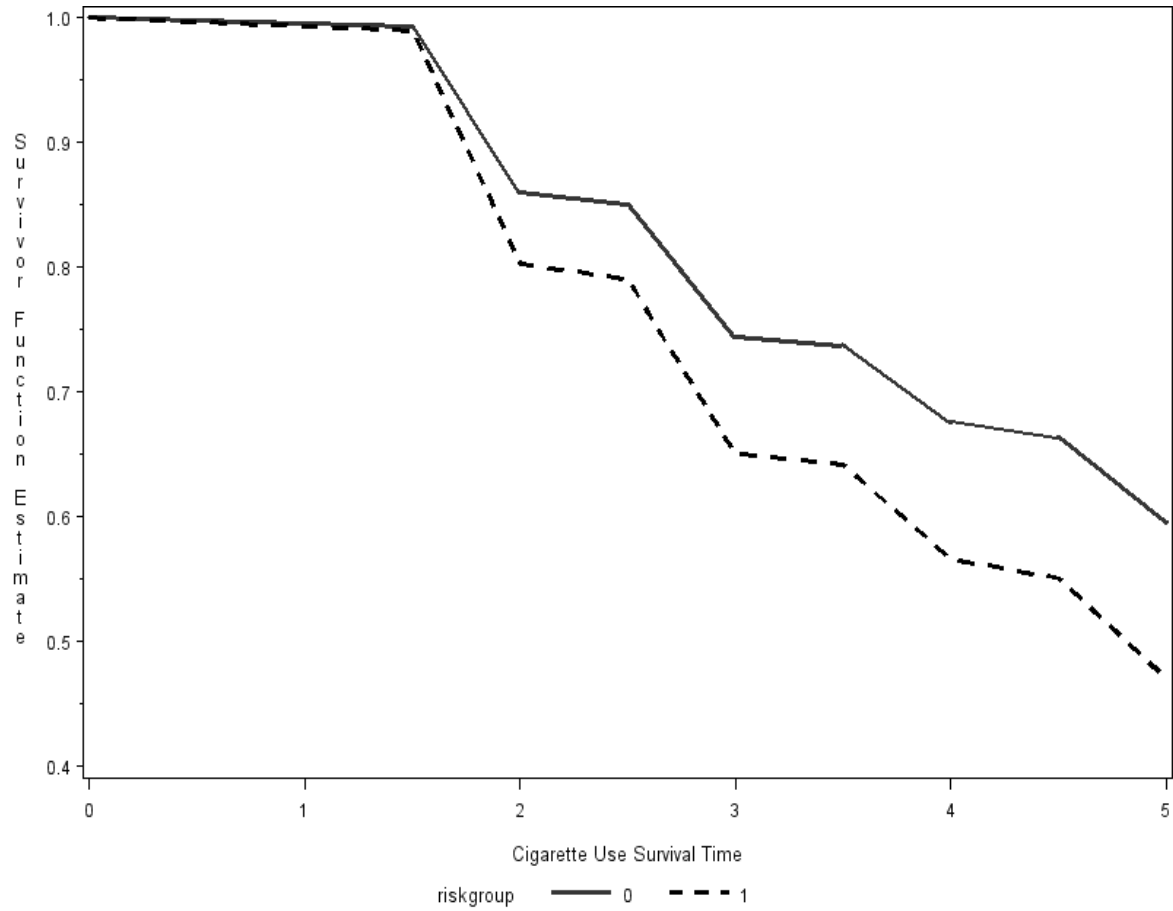


Figure 5.3

Cigarette Use Survival Function by Risk-group Status



## **Chapter 6 DISCUSSION**

### **Middle School Experiences and Substance Use Behavior**

Early onset of substance use in adolescence remains a grave health concern. Generally, initiation before age 13 is regarded as an indicator of early onset. This time roughly corresponds to the beginning of middle school. The middle school period is a significant phase in child and adolescent development as children move into middle school while transforming into early adolescents. Middle school with its large-scale and impersonal nature intersects with individual development, and tends to invoke adolescent developmental vulnerabilities (Eccles et al., 1993; Juvonen, 2007). From a Stage-environment Fit theoretical perspective, early adolescents need to experience a school environment that provides cognitive challenges and emotional support. In reality, the middle school environment often fails to respond these developmental needs; it even undermines positive adjustment (Felner, Seitsinger, Brand, Burns, & Bolton, 2007). Extensive educational research documents various declines in academic and psychological domains that are due to mismatch between perceived school contexts and developmental needs during the transition year (e.g., Eccles et al., 1993) and long-lasting impact beyond the transition year (e.g., Eccles et al., 1996). These perceived unconstructive aspects of school include school climate, teacher-student relationship, and teacher support, and to a great degree undermines early adolescents' sense of school connectedness (Juvonen, 2006). Noticeably as sense of school connection declines, in responding to mismatched school



contexts, early adolescents' school academic engagement behaviors appear to decrease during middle school as well (Anderman, 2003; Eccles et al., 1993, 1996; Eccles, Lord et al 1997; Hamm & Faircloth, 2005). It is evident that lack of school connection and school disengagement are at least partly responsible for declines in academic-related outcomes (Juvonen, 2006).

However, the application of the Stage-environment Fit model is in general limited to educational studies that center on academic- or self-related outcomes. In addition, substance research that has explored the effect of school connectedness and disengagement has not directed enough attention to the middle school student population and the effect of their schooling experience on substance use behavior. Hence there is a need to address concerns of how middle school adjustment might be related to substance use behavior, not only from an educational perspective but also from a public health point of view since middle school is the time that early onset of substance use starts.

To address a void in the literature, the present study extended the application of the Stage-environment Fit model to investigate the influence of the aspects of the middle school adjustment experience on early adolescent substance use and initiation. These aspects included early adolescents' perception of school context and their school disengagement behavior. They reflected the manifestation of the mismatch between perceived school context and the developmental needs in cognitive and behavioral dimensions. The specific aims of the study were to examine to what extent school adjustment (as measured by school connectedness and disengagement) during the first-year of middle school (i.e., sixth grade), and overall middle school adjustment, were associated with cigarette/alcohol use at the end of middle school (i.e., eighth grade). More specifically,

the study examined the extent to which adjustment in middle school was associated with cigarette and alcohol use concurrently and longitudinally for individual adolescents; and the extent to which high risk of problematic adjustment during the middle school period was associated with cigarette and alcohol use longitudinally, with regard to risk groups that were classified based on social contexts. This study drew on a recent longitudinal data set to assess the impact of developmentally transitional adjustments on health risk behaviors. The results extended previous findings that adolescents' school experiences were related to their substance use by examining key aspects of adjustment during and beyond the transition to middle school, to explain increases in cigarette and alcohol use observed over time, as well as initiation patterns.

The investigation was conducted in two steps, first on concurrent then longitudinal relations. The concurrent relations focused on the effect of the experience of the transition year of middle school. The transition year (i.e., the first year of middle school) in particular greatly challenges youngsters' adaptive ability. A large body of research on the middle/junior high school transition has documented the negative relations between adjustment during the transition year, and school-related academic achievement, motivation/interest and self-esteem (e.g., Eccles et al., 1993, 1996; Eccles, Lord et al., 1997; Roeser et al., 1998, 1999, 2000). The present study took a different approach by assessing the effect of sixth graders' adjustment on their cigarette and alcohol use at the end of sixth grade. The study findings revealed very strong concurrent associations between middle school adjustment and substance use behaviors in sixth grade. Students who felt a connection with their schools and teachers, and who were actively engaged in school work, were less likely to smoke or drink during the transition year. As Juvonen

(2006) concludes, students who are socially attached to school and teachers function better in school than do those who are socially detached. Connections with school and teachers reinforce participation in behaviors that are sanctioned by school (Karcher, 2003), and can serve as a protective factor against the initiation of health-risk behaviors (McNeely & Falci, 2004). The present study provided additional support to the link established by extant cross-sectional studies (e.g., Wang et al., 2005; Yan et al., 2008) between school connectedness and substance use behaviors by focusing on middle school students. The findings of the study verified Hirsch's (1969) suggestion that strong attachments with conventional institutions such as schools can lessen the risk of engaging problem behaviors among youth.

In addition to concurrent influence, adjustment in middle school can have long-term implications for developmental mal-adaptation beyond the middle school years. Educational studies have demonstrated that students with negative experiences in the first year of middle school or junior high school tend to exhibit lower self-esteem in 10<sup>th</sup> or 12<sup>th</sup> grades (e.g., Eccles, Lord et al., 1997; Roeser et al., 1998, 1999, 2000). The present study took two different approaches to examine the long-lasting impact of middle school adjustment on health-related behaviors. First, only adjustment during the first-year of middle school was analyzed in relation to substance use in eighth grade. The findings uncovered that one of the adjustment indicators—sixth-grade school connectedness — was strongly associated with cigarette and alcohol use in eighth grade. This association mirrored the findings documented by studies using national representative samples (e.g., McNeely & Falci, 2004), suggesting that adolescents who perceived high teacher support were less likely to initiate substance use, given that teacher support is an element of school connectedness (Battistich et al., 1995).

The relations between the other adjustment indicator included in the study—school disengagement — and substance use were complex in the present study. Across several studies, Bryant (e.g., Bryant et al., 2000, 2003; Bryant & Zimmerman, 2002) reported that high levels of school misbehavior and low levels of academic achievement in early adolescence were associated with high concurrent substance use and increased use over time. Earlier research findings (e.g., Hawkins et al., 1992; Petraitis et al., 1995) also suggest that school disengagement behaviors are risk factors for substance use. However, the results of the current study did not reveal in this particular sample that early adolescents' sixth-grade disengagement behaviors was related to their substance use behavior in eighth grade. Yet when school disengagement was taken into account continuously from sixth grade to eighth grade, it was significantly associated with early adolescent substance use behavior. This finding is discussed more fully in the following section.

The second approach in the study to investigate the long lasting relations between the school adjustment and substance use was to follow sixth graders across the middle school period, monitoring the impact of their development over time. As youngsters move through the middle school years, they may continuously develop strategies to manage stresses associated with the developmental transition period (Eccles et al., 1993); they may also develop adaptive abilities to navigate through and negotiate with the middle school environment; or they may change in their perceptions of the school and respond to the school environment with a different set of school-related behaviors (Anderman, 2003; Hamm & Faircloth, 2005). Such a dynamic adaptive process requires a rather extended study period to capture potential changes. The present study took full advantage of a

longitudinal design in which participants were followed for a total of two-and-half-years, measured at five time points. In contrast to the first approach in which logistic analysis was used to evaluate the influence of the first-year adjustments on substance use at the end of eighth grade, the second approach was to employ the growth curve modeling technique to capture the fluidity and time-dependent nature of students' schooling experiences by incorporating school connectedness and school disengagement behavior in the models as time-varying predictors across five time points.

The findings lent support to the study hypothesis that middle school adjustment was significantly associated with cigarette and alcohol use over time. Experiencing strong connections with school throughout middle school considerably reduced the risk of both cigarette and alcohol use in middle school. In addition, the more disengaged from school in middle school, the more likely early adolescents were to engage in cigarette and alcohol use. It appears clear that sense of connectedness and school engagement are critical for early adolescents to successfully adapt to the middle school environment, not only in academic domains (Juvonen, 2006), but also in health-related domains, including substance use.

These findings from the growth curve analysis underscore the importance of the positive connection with school and school engagement over time. It is consistently revealed in every analysis that school connectedness matters to substance use behavior concurrently and longitudinally; it is also indicated that school disengagement has influence in a long run, although there is a mixed finding in logistic analysis. From a Stage-environment Fit conceptual standpoint, when students have a hard time establishing and maintaining positive relationships in school and display behavior problems, developmental

vulnerability may increase in academic areas (Seidman & French, 2004) and in health-related domains. It is particularly challenging for students who are not only unable to connect with the school setting, their teachers or their peers but who also exhibit high frequency of school disengagement behaviors in middle school.

The application of the Stage-environment Fit model to examine the influence of the developmental transition time on health outcomes represents a novel approach to understanding substance use behaviors. The findings from the current study demonstrate the appropriateness of this framework to understanding the effect of middle school experiences at a key developmental transition time on early adolescent health behaviors. The results of the current study offer additional evidence that negative adjustment can take place in health-related domains, and are not limited to academic outcomes, which represent the most common domain to which the Stage-environment fit theory is applied. The conceptualization of the study extends the existing substance use research that has a focus on school connectedness of older adolescents (e.g., McNeely & Falci, 2004) by incorporating the schooling experience of middle school students in the middle school years into adolescent substance use research, and indicates that the Stage-environment Fit model may inform our understanding of the complex relation between adolescents' school experiences and substance use, and the role of perceived school context in early adolescent health behaviors when substance use initiation begins in the middle school period.

#### Risk Factors in Early Adolescent Social Ecology and Substance Use Behavior

To achieve a more thorough understanding of proximal environmental risks presented in adolescent social ecology during middle school, in addition to school contexts,

the study drew from Bronfenbrenner (1979)'s ecological perspective to take adolescent family and peer contexts—critical components of microsystems in adolescent life— into consideration. Literature on substance use clearly demonstrates parental and peer influences on adolescent substance use (Avenevoli & Merikangas, 2003; Kobus, 2003). Neglect of risks in family and peer contexts may lead to overestimate the effects of school contexts as a result of the influence of correlated contexts (Cook, 2003; Cook et al., 2002).

Simultaneously examining school, family and peer group presents a daunting task to researchers. The present study adopted a multiple-risk approach to summarize the risk factors identified in each context to generate viable background information in order to evaluate the joint influence of these contexts on adolescent substance use. This line of the investigation was restricted to a subgroup of students in the sample who were characterized as not being having initiated either cigarette use or alcohol use in sixth grade. The intent was to investigate risk factors that are salient to the developmental transition period by moving beyond the influence of well-known risk factors in family and peer contexts. Sameroff (2000) argued that identification of risk factors is a process of estimating probabilities of factors that produce maladaptive variations in the life course. In adolescent development, there are multiple contributors to undesirable outcomes at multiple levels in an adolescent's social world. Risks rarely occur alone, instead tend to cluster in the same individual (Sameroff, 2000; Sameroff & Fiese, 2000). Focusing on a single risk factor does not address the reality that many adolescents often experience multiple risks or recurring stressors simultaneously (Sameroff & Gutman, 2004). Following the same vein of thinking, the present study focused on seven conditions that are salient to adjustment during the developmental transition period, and involved a classification of participants into two

groups (high-risk versus low-risk) based on the total number of risks to which they were exposed. Extending past research that only examined risks in school and family (e.g., Sale, Sambrano, Springer & Turner, 2003) or school and peer (e.g., Abbey, Jacques, Hayman, & Sobeck, 2006), in the current study, the hypothesis that the high-risk group had higher odds of initiating cigarette or alcohol was tested.

Two approaches were adopted to address these questions. The first approach was to conduct logistic regression to examine the probability of initiating substance use within a relatively short one-year interval (from the end of sixth grade to the end of seventh grade) with regard to risk-group membership. After controlling for common risk factors identified by substance research (e.g., friend and parent substance use behaviors), the high-risk group had considerably higher odds of cigarette use initiation. The second approach was to explore whether or not the high-risk group would initiate substance use earlier than the low-risk group over the course of middle school. Using the discrete-time proportional survival analysis, a similar pattern emerged. The high-risk group membership was significantly associated with increased hazard of initiation of cigarette use. In other words, the high-risk group more quickly took up smoking between sixth and eighth grade. It appeared that the number of risk factors was reliably predictive of smoking behavior, given that the high-risk group was more inclined to initiate smoking earlier than the low-risk group.

A significant contribution of this aspect of the present study is its focus on the factors that are salient to adaptive development in this particular transition period in three early adolescent proximal environments, rather than narrowing on the common factors that are known to pose risk to early adolescent substance use such as peer influence or family influence. As discussed earlier, maladjustment in middle school has a profound negative



influence on later development (Eccles et al., 1993). It is also well known that family environment and peer group are significant influence that might enhance adolescent health and psychological adjustment (e.g., Brown, Dolcini & Leventhal, 1997; Galambos & Ehrenberg, 1997; Kobus, 2003). At a developmental transition period a fit between family environment and early adolescent developmental needs is critical (Eccles et al., 1993); establishing and maintaining peer networks is equally important for young people to receive companionship, advice, and support in time of need (Rubin et al., 1998) when perceptions of minimal peer support and approval for school-appropriate behaviors increase during early adolescence (Juvonen & Cadigan, 2002). Taken together, the risk factors in the study highlight experiences in adolescents' social ecology whose negative influence may increase developmental difficulty, thus making early adolescents more susceptible to health-compromising behaviors during the middle school years.

Moreover, the risk of early initiation lies in the cumulative effect of these factors that reside in multiple contexts. Any single variable is neither necessary nor sufficient for producing an outcome of substance use (Sameroff, 2000; Sameroff & Gutman, 2004; Wachs, 2000). Sameroff (2000) concluded that at the population level, each social factor contributes to the health of developing adolescents, but for each individual there will be a unique combination of factors working their influence. Considering that the contribution of each factor to certain outcomes may vary across individuals, the same set of factors may result in a range of probabilities that are associated with various adaptive outcomes.

One notable finding in the risk-factor analysis is, that it appeared that the risk factor variables (risk-group indicator and risk score) were only related to cigarette use but not alcohol use. Using the same master data as the current study, Ennett, Foshee et al. (2008)

have tested the effect of a series of indicators that characterized school, family, and peer context on adolescent alcohol misuse in a statistic model built upon Bronfenbrenner (1979)'s microsystem. These findings did reveal a significant association between some indicators and alcohol misuse. The distinction between the study of Ennett, Foshe et al. (2008) and the present study is that, (1) the former was not a cumulative risk analysis, and (2) the study population in the former study was adolescents ages 11 to 17, whereas the adolescents in the present study were younger, mainly ages 11 to 14. A study by Sale et al. (2003) employed the concept of risk factor to investigate the relationships between risk factors (in school, family, and community) and substance use in the youth population of age 9 to 18. Yet risk in Sale et al. (2003) was operationalized very differently from the current study. Due to methodological and study population differences in these studies and the present study, more inquiry is needed to clarify why the risk factors were not related to alcohol use in the present study.

The risk approach used in the current study was to investigate the effect of the presence of risks on early adolescent substance use. Conversely, a different question can be framed, which focuses on the association between the presence of positive influences and early adolescent substance use. Sameroff (2000, p. 19) proposed the concept of "promotive factor" to describe positive influences in social contexts rather than using the term protective factor. The distinction between promotive factors and protective factors is that a promotive factor would have a positive effect in both high- and low-risk populations; the latter only facilitates the development of high-risk population. To address the effect of promotive factors in the study, a multiple promotive-factor score would be created to sum over the promotive factors identified in adolescent social ecology, such as strong school

connectedness. Then an analytic strategy similar to the analysis of risk factors would be performed. The results would reflect to what extent the positive influences would reduce the risk of initiation of cigarette or alcohol.

Conducting both the risk- and promotive-factor analysis enables the researcher to compare the positive and negative effects of social factors in early adolescent life to understand the process that lead to substance use. It yields vital information for designing appropriate interventions and maximizing the efficacy of intervention efforts for early adolescents. As for the choice of implementing the risk-factor analysis in the current study, since it directly assessed negative effects of the factors in early adolescent social ecology, it more aligned with the focus that the Stage-environment Fit model proposes, which emphasizes that negative experiences in middle school and adolescent family in early adolescence can result in adolescent maladaptation in a developmental transition period.

### Methodological Considerations

A strength of the present study was the inclusion of multiple analytical methods to address research questions. Specifically, the study took full advantage of the data set that followed sixth graders to the end of eighth grade, using five points of measurement (roughly 6 months apart). The longitudinal design with multiple time points meant that analyses were not confined to a single analytic approach to address the long-term relationship among students' schooling experience and substance use behaviors. In addition to using logistic regression, the study effectively utilized growth curve modeling (GCM) to test the association between the mean developmental trajectories of cigarette/alcohol use and school adjustment over the middle school years in that there was a steady increase in cigarette and

alcohol lifetime use over the course of middle school in the data, and standard GCM involves a process in which population members follow a common developmental pattern of either increase or decline (Raudenbush & Bryk, 2002). Further, the study applied survival analysis with a focus on the relationship between the exposure to developmentally salient risks and cigarette/alcohol initiation. Both analyses confirmed the associations among the middle school adjustments, the risk factors and substance use behaviors. The GCM results underscore the negative middle school adjustment is associated with increased cigarette and alcohol use at the population level; the survival analysis results call attention to the high-risk group that was exposed to the number of risk factors that is one standard deviation above the mean among the subpopulation, and demonstrate how fast the high-risk group members could start smoking or drinking alcohol, compared with those in the low-risk group.

An alternative approach to GCM not investigated in the current study, would be to capture the dynamic nature of students' schooling experiences through latent curve modeling (LCM). GCM is an extension of an HLM framework; LCM is developed within a structural equation modeling (SEM) framework (Bollen, 1989; Bollen & Curran, 2006). Both GCM and LCM models for longitudinal data share the objective of modeling individual differences in patterns of change (MacCallum, Kim, Malarkey & Kiecolt-Glaser, 1997). They can be applied to the same data structures, allowing both individuals and outcome variables to be measured at different occasions and different numbers of occasions (MacCallum et al., 1997). Yet utilization of LCM models provides additional information about the assessment of model fit through an emphasis on the assessment of overall model fit, while GCM is mainly concerned with evaluation of parameter estimates and comparisons of nested models (Singer & Willet, 2003). Mathematically speaking, these two types of models are equivalent

(MacCallum et al., 1997). The reason for choosing GCM instead of LCM in the present study was because evaluation of parameter estimates was in the best interest of the study.

Another methodological consideration is given to the multiple-risk model used in the present study. In practice, this method involves making arbitrary cut points on underlying continuous distributions of each factor in order to determine high or low risk status. This risk-factor analysis provides the entry point for selecting a population for special treatment given intervention resources are generally limited (Sameroff, 2000). Information generated by such analysis describes the effect of risk factors at the population level. At the same time, theory and empirical evidence suggest important differences in how adolescent substance use develops over time with respect to subpopulation. For example, Moffitt (1993) distinguished between adolescent-limited and life-course-persistent patterns of antisocial behavior. To identify patterns of substance use, it is important to follow individual adolescents over time by observing how young people's substance use changes, thus to distinguish different patterns that characterize the path of risk behavior (Cairns & Cairns, 1994). In light of the fact there are adolescents who exhibit similar outcomes resulting from the different set of risks and adolescents who display different outcomes resulting from the same set of risk (Sameroff et al., 1993), two alternative methods are discussed with regard to understanding substance use patterns in subgroups in the current data. Although both are pattern-oriented, a basic distinction is made between model-based and descriptive methods (Bergman & Magnusson, 1997). The model-based method is presented first, followed by the descriptive approach.

The first method is the group-based trajectory analysis (GTA) proposed by Nagin (2005). Methods like GCM have been used to study developmental patterns in substance use

research with a focus on differences across several time points (Muthén & Curran, 1997); however the distinction between GCM and GTA is defined by their underlying assumptions. First, an assumption of GCM is that the parameters are continuously distributed throughout the population according to the multivariate normal distribution (Singer & Willett, 2003). Unconditional models define average growth within the population and the variances of growth throughout the population by estimating trajectory parameters' mean and covariance structure respectively. The conditional models explain individual-level heterogeneity by relating trajectory parameters (i.e., intercept and slope) to one or more explanatory variables. The purpose of GCM is to identify the factors that account for individual variability about the population's mean trajectory of development (Singer & Willett, 2003). It is suitable for answering questions framed with respect to predictors for the developmental course of the outcome of interest. By contrast, GTA assumes that there may be outcome clusters that show distinctive developmental trajectories that may reflect unique etiologies (Nagin, 2005). The purpose of GTA is to identify factors that distinguish group membership and demonstrate how groups differ. By identifying clusters of individuals with similar developmental trajectories, differences that may explain individual-level heterogeneity can be expressed in terms of group differences. It is suitable for analyzing questions framed in terms of the shape of the outcome's developmental course.

Given that GTA does not require the assumption that all individuals follow a process that increases or decreases regularly within the population, it is usefully applied to phenomena in which there are qualitatively distinct trajectories of change over time across subpopulations that are not identifiable by existing demographic characteristics such as gender or ethnicity (Nagin, 2005). For future study, a first step would be to identify

distinctive group trajectories with respect to cigarette and alcohol use through GTA, and then to link group membership to individual characteristics to examine how groups vary.

The second alternative approach is to use cluster analysis to determine whether or not there are distinct developmental patterns in the study population. First, this approach aims to understand how multiple contributors in individuals' social ecology (school, family and peer group) are associated with substance use over time. Different adolescents can be portrayed by different profiles of such "person variables," and these variables are components of the pattern under analysis and only interpreted in relation to other variables considered simultaneously (Bergman & Magnusson, 1997). Such group profiles provide insights into individual differences in health outcomes such as what individual attributes distinguish the clusters of rare alcohol user, non-escalating alcohol user and escalating user (Steinman & Schulenberg, 2003). Second, such analysis sheds light on how the social environments that youth experience aid or inhibit substance use behavior, because group profiles offer a more complete picture of the differential social affordances and constraints in the school, the family, and the peer group in relation to health outcomes among different subgroups of youth. Application of this approach reflects a holistic perspective on adolescents' health functioning in adolescent development in that each individual adolescent is an indivisible whole (Bergman & Magnusson, 1997; Roeser & Peck, 2003).

### Limitations of the Study

There were some notable limitations in the present study. One limitation was that the school connectedness measures were limited in their ability to measure additional dimensions of school connectedness. The construct of school connectedness itself is a global construct

that contains multiple dimensions, including perceptions of the supportiveness of the school environment, teacher-student relations, and student autonomy (Battistich et al., 1995; Juvonen, 2006). The measure used in the current study emphasized the caring interpersonal relationship in school without specificity to source. Therefore, the study does not measure belonging or connectedness as is the case in other research (e.g., Basttistich & Hom, 1997), and does not reflect the relations between adolescent substance use and other dimensions of school connectedness. Because of the narrow operationalization of school connectedness, it is possible that the findings underestimated the influence of school connectedness on early adolescent substance use behaviors, as previous research reveals that perceptions of teacher support reduce the likelihood of initiation of cigarette (McNeely & Falci, 2004).

Another limitation of the methodological approach of the current study involved one of the peer relational variables, specifically, how many friends an individual adolescent as a proxy indicator of an adolescents' ability to form a new, supportive social network when navigating a novel and complex middle school environment following school transition. Literature on adolescent friendship includes debates over whether or not the number of friends is linked to supportive friendship, which plays a key role in adolescent school social adjustment (Savin-Williams & Berndt, 1990). Using a proxy indicator may be a weak indicator of intimacy and emotional support in adolescent friendship.

Another weakness was that the growth curve models estimated in the current study were unable to assess temporality of relationships. The models assessed the simultaneous relationships between the time-varying school adjustment measures and cigarette/alcohol use at each wave assessed; the models did not assess lagged effects of the school adjustments, that is, whether the maladjustments at earlier waves were associated with



cigarette or alcohol use at subsequent waves after controlling for previous use.

Autoregressive latent trajectory models can be conducted to assess lagged effects in the future research.

Finally, from a conceptual standpoint, the application of Bronfenbrenner's ecological framework is incomplete in a couple of ways. One way is that school differences were not considered for their effect on individual adolescents nested within each particular school. The reason was because the data set had an insufficient number of schools (i.e., total eight middle schools) to permit this kind of analysis. Research shows an array of school characteristics that may make a difference in students' perception of school connectedness or students' substance use behaviors (Battistich, Solomon, Watson & Schaps, 1997; Cleveland & Wiebe, 2003; Leatherdale, McDonald, Cameron & Brown, 2005; Voelkl & Frone, 2000). For instance, school poverty level generally is negatively associated with perceived school connectedness (Battistich et al., 1995, 1997). It is important to control of poverty level when examining the relation of school connectedness to other student behavioral outcomes. Additionally, if a student attends a school with a high prevalence of cigarette use or alcohol use, he/she is more likely to have opportunity to smoke or drink than is a similar student attending a school with a lower prevalence rate (e.g., Cleveland & Wiebe, 2003; Leatherdale et al., 2005). Future research using datasets that include more schools may be able to support such analyses. A second limitation in the application of ecological theory is that reciprocal relations between adolescents and their social contexts were not evaluated. As is often the case in secondary analysis, variable availability constrains study design. Specifically, the current data set did not offer variables that assessed how adolescent social contexts reacted and responded to changes brought by

adolescents' transitional adjustment to allow this type of analysis. Future research using datasets that contain this type of variables may be able to conduct such analyses

### Implication for Prevention and Intervention

The middle school years represent a turning point that provides an opportunity for growth and positive development in the course of adolescent development. Experiences during this transition can either alter or reinforce behavior in ways that change developmental trajectories (Shanahan, 2000). During this developmental phase, relations with peers and adults other than one's parents become increasingly important (Wentzel & Wigfield, 2007). Structural aspects of many middle schools (e.g., larger schools, more teachers for students to work with) can create barriers for early adolescents to form positive social relationships (Wentzel & Wigfield, 2007). Educators have long recognized the importance of a sense of connectedness and belongingness to students' motivation and interests (e.g., Juvonen, 2006, 2007). The present study has supplied additional evidence that such an environment reduces the likelihood of early adolescents' cigarette or alcohol use during this period. Substance use prevention/intervention programs that target at middle school students should contain components that promote a sense of belonging and connectedness, for example, creating a personalized school context, as Felner and his colleagues (Felner et al., 2007) have proposed, or helping teachers understand early adolescent development and how to create alignment between their students' experiences of school context and their developmental needs, as Hamm and her colleagues have argued (Hamm et al., in press). The purpose of creating small personalized environments is to make school contexts more developmentally relevant, and the adults in them more

developmentally aware. Teachers equipped with knowledge about the nature of developmental change in early adolescence can construct a developmentally appropriate classroom environment. Through a positive and supportive school and classroom environment, early adolescents can actively engage in building on connections to the teacher and peers rather than resorting to health-compromising behaviors as they go through middle school. The findings from this dissertation also demonstrate that students' experiences of the transition year (i.e., sixth grade) had a profound effect on later substance use behaviors. Such findings suggest that programs that prepare early adolescents for the transition may be incorporated with school-based substance-use prevention/intervention programs to facilitate transitional adjustments and, at the same time, to reduce the risk of early onset of substance use.

In sum, the current study addresses the importance of schooling experience to substance use behaviors in early adolescence. The findings lend support to links between middle school adjustment and adolescents' cigarette or alcohol use behaviors, concurrently and longitudinally. The findings also demonstrate that the cumulative influence of risk factors in school, family and peers is associated with certain odds of cigarette use initiation in terms of magnitude of exposure to risks. The findings support the generality that school, family, and peer contexts are significantly implicated in adolescent cigarette use. Future research should continue to explore the relationship between schooling experiences, adolescent social ecology and cigarette/alcohol use to identify developmental patterns during the middle school years.

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