CHILDHOOD TEMPERAMENT AS A PREDICTOR OF SUBSTANCE USE IN EARLY ADOLESCENCE

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This project examined childhood temperament as a predictor of substance use in early adolescence. Many previous studies of temperament and substance use were cross-sectional, and thus could not address the direction of this relationship. Previous longitudinal studies did not address childhood temperament as a risk factor for substance use. In addition, many studies only considered a small number of covariates of substance use. This study improved on previous studies by collecting childhood temperament data at ages when substance use is rare, and addressing the direction of this relationship. In addition, substance use data were collected in early adolescence and other covariates were analyzed.

The data were from a longitudinal, epidemiological study of the effects of prenatal substance use, and included covariates of substance use such as maternal substance use and psychiatric symptoms, child psychiatric symptoms, and family history of substance use problems. Temperament was measured at ages 6 and 10 using the Emotionality, Activity, Sociability, and Shyness Survey (Buss & Plomin, 1984). Substance use outcomes were measured at age 14 with the Health Behavior Questionnaire (Jessor, Donovan, & Costa, 1989), which measures the quantity and frequency of substance use, including cigarettes, alcohol, and marijuana.

Increased sociability and increased activity at age 6 predicted ever having tried a cigarette by age 14. This relationship remained significant when controlling for other relevant covariates. Temperament at ages 6 and 10 did not predict alcohol, marijuana, or polysubstance use outcomes, although increased sociability did predict escalation of marijuana use. This project

also identified common and unique predictors of the initiation and escalation of use of specific substances.

Children with high levels of activity and sociability at age 6 are at increased risk for substance use in early adolescence. The public health importance of these findings is that parents or teachers can easily identify these traits at young ages. Prevention efforts may then be aimed at these children starting in early elementary school in the hopes of reducing and delaying the initiation of their substance use in adolescence. These results may also be used to tailor prevention and intervention efforts to use of specific substances.

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PREFACE

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I. INTRODUCTION

Substance use before age 15 has been associated with increased risk for substance use disorders later in life. Additional risk factors, such as prenatal substance exposure, having a biological parent with a substance use problem, temperament and/or personality traits, poor family relationships and/or quality of the home, substance using peers, and gender, are also related to substance use in adults. The identification of risk factors earlier in life, such as in childhood, could help us tailor prevention efforts to the needs of children at high-risk for substance use disorders in later life. As temperament has been shown to be relatively stable throughout the life span, it is an interesting factor to examine, since a temperamental predisposition towards substance use would put an individual at risk for their entire life. Numerous studies have examined the association between substance use and temperament characteristics. However, the ways in which childhood temperament predicts substance use in early adolescence are still unclear.

Numerous cross-sectional studies of the association between temperament and substance use have been completed on adolescents. Difficult temperament, as well as individual temperament dimensions, including increased activity, novelty seeking tendencies, and anxiety, and decreased mood have been associated with increased risk for substance use (Tarter et al., 1990; Wills et al., 1994, 1995, 1998; Windle, 1991). However, many of these studies were conducted with specific populations, and did not assess the directionality of the relationship

between temperament and substance use. The direction of these relationships is important because it is still debatable whether deviant personality factors preceed, or are consequences of, substance use. In order to address these questions, longitudinal analyses are needed.

Longitudinal research on predictors of substance use and/or abuse has been conducted in samples from kindergarten through adulthood. These longitudinal studies have found that increased aggression and lower levels of social closeness increased risk for substance use (Brook et al, 1986, 1990; Caspi et al., 1997; Fleming et al., 1982; Krueger et al., 1996). Again, some of these studies were conducted with specific subgroup populations, and they did not address whether early temperament predicts adolescent substance use, particularly in earlier adolescence.

Finally, fewer studies have directly examined the effects of childhood temperament on adolescent substance use. Lerner & Vicary (1984) found that the presence of a difficult temperament at age 5 and in adulthood significantly predicted all types of substance use in adulthood. However, no other variables related to substance use were controlled for in this analysis, so the effects of temperament may diminish when other variables are entered into the model. Dobkin et al. (1995) and Masse and Tremblay (1997) found that novelty seeking and harm avoidance dimensions, measured at ages 6 to 10, predicted alcohol, drug, and cigarette use, and that characteristics of the child were better predictors of early-onset substance abuse than friends' behavioral characteristics. These studies involved an all-white, low socioeconomic status (SES) group of boys, which makes it difficult to generalize the finding to other populations, particularly female populations. Also, there is a lack of information about parent and family characteristics, as well as a lack of information about the boys from either parent report.

In summary, most of the studies of temperament correlates of alcohol use and other substance use only look at cross-sectional data, which does not allow one to distinguish whether the personality factors are antecedents to or consequences of substance use. Even many of the longitudinal studies do not include childhood measurements of temperament, so they are also unable to assess the directionality of the relationship. Also, many studies focus on only a single substance, which leaves the question of whether the correlates are specific to the substance use disorder (SUD) of interest, or whether they reflect more generalized addictive tendencies.

The Maternal Health Practices and Child Development Project, a longitudinal program of research on the effects of prenatal substance exposure, has a valuable data set, which includes measures of temperament from ages 6 and 10 using the Emotionality, Activity, Sociability, and Shyness Scale (EAS, Buss & Plomin, 1984). Other variables related to substance use (e.g., family history of substance use, psychopathology, quality of the home environment) are also included. These data are available not only during the time period of the outcome of interest (early onset substance use – age 14), but also during ages when substance use is very rare (ages 6 and 10). Thus, some questions of interest are; do the temperament characteristics of adolescents who use substances early in life (at age 14 or younger) differ from the temperament characteristics of abstainers? And can these differences be detected in childhood (at ages 6 and 10)?

The primary goal of this investigation was to examine if childhood temperament predicts the early onset of substance use in 14-year-olds, while controlling for a variety of risk factors that have previously been associated with adolescent substance use. This study examined whether early measures of temperament characteristics at age 6 and at age 10 predicted the onset of substance use, including alcohol, tobacco, and marijuana, by age 14.

II. LITERATURE REVIEW

In general, substance use in adolescence has been decreasing or has remained steady in recent years, but there are still a great number of adolescents who use substances (Johnston et al., 1996, Johnston et al., 2004). Since earlier substance use is associated with higher risk for serious health consequences and adult substance use, the identification of risk factors earlier in life, such as in childhood, could help us tailor prevention efforts to the needs of children at high-risk for substance use disorders in later life. One of the early risk factors that has been studied extensively is temperament. However, there are still many unanswered questions such as whether the temperament characteristics of adolescents who use substances early in life (at age 14 or younger) differ from the temperament characteristics of abstainers. In addition, it is not known whether these differences are detectable earlier in childhood (at ages 6 and 10). In order to address these questions, one must have an understanding of the epidemiology of adolescent substance use, as well as an understanding of the other risk factors associated with substance use.

A. ADOLESCENT SUBSTANCE USE

1. Epidemiology of Adolescent Substance Use

The 2005 prevalence estimates from the Monitoring the Future series, an annual survey of nationally representative samples of 12th graders since 1975, and of 8th and 10th graders since 1991, show that 21.4%, 38.2%, and 50.4% of 8th, 10th, and 12th grade students, respectively, have used an illicit drug at least once in their lifetime (Johnston et al., 2006). Eighth grade substance use rates are of particular interest to this investigation, as they highlight the extent of the early onset of adolescent substance use. The Monitoring the Future study shows that among 8th graders, approximately 41% have used alcohol, 26% have used cigarettes, 17% reported having used inhalants, 17% reported marijuana use, and 7% reported the use of amphetamines at least once in their life. Prevalence estimates of more serious substance use show that approximately 4% of 8th graders used cigarettes on a daily basis, and 11% consumed 5 or more drinks in a row in the past two weeks. These data highlight an important problem, as they show that substance use among adolescents, particularly those in early adolescence, is not uncommon.

The prevalence rates of illicit substance use among American high school seniors increased sharply in the 1960s and 1970s, and decreased during the 1980s. This was particularly true for marijuana use (O'Malley et al., 1999). Prevalence rates have increased in the 1990s in comparison to the prevalence rates from the preceding decade. Marijuana use increased 155%, 74%, and 45% for 8th, 10th, and 12th graders, respectively, along with increases in the use of other substances, including inhalants and cigarettes, particularly in the younger adolescents (O'Malley et al., 1999). These rates may be somewhat conservative, as school-based surveys exclude dropouts and habitually absent students, groups known to have high rates of substance use

(Weinberg et al., 1998). The National Household Survey on Drug Abuse (NHSDA) (Substance Abuse and Mental Health Services Administration, 1996), a home-based survey of adolescent substance use, which includes these groups, reports similar trends. These also yield conservative estimates, since fewer adolescents report substance use when interviewed in their homes (Weinberg et al., 1998). The levels of substance use reported in the 1999 findings (O'Malley et al., 1999) have remained relatively steady from the late 1990's through 2002 (Johnston et al., 2004). The Youth Risk Behavior Survey (YRBS) reports similar trends in cigarette, alcohol, and marijuana use (CDC, 2004), although it has similar limitations as the Monitoring the Future data, as this survey is also conducted among high school students.

Although the Monitoring the Future study only reported subgroup differences among 10th graders, the results clearly show differences in adolescent substance use by gender and racial/ethnic group. Males reported higher rates of substance use than females. African-Americans had lower rates of use than Whites or Hispanics, who had similar rates. Hispanic and White males had the highest rates of use of the major illicit drugs (marijuana, hallucinogens, cocaine), followed by Hispanic and White females, then African-American males, with African-American females reporting the lowest usage rates of these substances (Johnston et al., 2004).

2. Consequences of Adolescent Substance Use

There are many serious consequences associated with adolescent substance use, and studies have shown that children who initiate substance use at earlier ages are at higher risk for serious health consequences and adult substance use than those who initiate substance use at later ages (Fergusson & Lynskey, 1996; Kalant, 2004; Robins, 1984; Tennant & Detels, 1976; Wu et al., 1988; Yu & Williford, 1992). Adolescents who use substances early are more likely to take

part in high-risk behaviors, including driving under the influence (NCHS, 1992). Many injuries and fatalities in adolescence, whether accidental or intentional, are often associated with substance use (Milstein & Irwin, 1987; NCHS, 1992). The adolescent fatalities associated with substance use represent one of the leading preventable causes of death in the 15- to 24-year-old population (NCHS, 1992; Schwartz et al., 1986; Smith, Schwartz, & Martin, 1989). Bukstein (1995) showed that adolescent victims and perpetrators of violence, either with or without a weapon, are commonly current substance users, or have histories of SUDs.

Another set of high-risk behaviors associated with adolescent substance use includes sexual practices. DiClemente and Ponton (1993) showed that the early onset of substance use and abuse was associated with early sexual activity in adolescents, while Rotheram-Borus, Koopman, and Ehrhardt (1991) showed that unsafe sexual practices were common among adolescents who used substances. An intoxicated state produces impairment in judgment and increased impulsivity, which may lead to unprotected and/or unsafe sexual practices and subsequent pregnancy and/or sexually transmitted disease (Bukstein, 2002). The long-term effects of chronic substance use that may or may not become apparent until later include liver disease, memory problems, and lung cancer and other pulmonary diseases such as emphysema (Bukstein, 2002; Martin et al., 1995).

Finally, adolescent substance use has been associated with a low degree of commitment to school. The Monitoring the Future study showed that the use of several substances, including cocaine, heroin, and sedatives, was significantly lower among those students who expected to attend college than among those who did not (Johnston, O'Malley, & Bachman, 1985). Other factors, such as how much students like school (Kelly & Balch, 1971), time spent on homework, and the perception of the relevance of schoolwork, are also related to drug use levels, indicating

a negative relationship between frequent drug use and commitment to education among 11th and 12th graders (Hawkins, Catalano, & Miller, 1992).

Jessor and Jessor (1977) have hypothesized that these high-risk activities, including drinking, problem drinking, marijuana use, delinquent behavior, and precocious sexual behavior, constitute a syndrome of problem behavior. Jessor and Jessor (1977) originally developed Problem Behavior Theory to account for variation in adolescent participation in problem behaviors, defined as behaviors which conventional society views as undesirable. The theoretical framework of Problem Behavior Theory involves a large number of risk/protective factors divided into three major systems including the personality system, the perceived environment system, and the behavior system (Donovan, 1996; Jessor & Jessor, 1977).

The personality system is composed of three sets of variables; 1) the motivational-instigation structure, measured by indicators of the value placed on, and expectations for, the goals of independence and achievement, in which each measure influences behavior, 2) the personal belief structure, which includes variables that may make an individual more or less vulnerable to problem behaviors, such as internal-external locus of control and self-esteem, and 3) the personal control structure, composed of indicators believed to be directly related to problem behavior, which includes measures of tolerance of deviance and religiosity (Jessor & Jessor, 1977). The perceived environment system is composed of two structures; 1) the distal structure, measuring whether the individual is parent and family oriented (less prone to problem behavior) or friend and peer oriented, and 2) the proximal structure, which is measured by the extent to which problem behaviors are modeled and supported in the individual's proximal perceived environment (Jessor & Jessor, 1977). Finally, the behavior system is composed of two structures; 1) conventional behaviors, behaviors deemed desirable and appropriate by society,

often assessed by church attendance and academic achievement, and 2) problem behaviors, behaviors deemed inappropriate or undesirable by conventional norms (Jessor & Jessor, 1977). Within the context of the Problem Behavior Theory framework, demographic and socialization variables affect the personality and perceived environment systems and have a "distal" or indirect impact on behavior, while the personality and perceived environment systems are proximal or more direct determinants of behavior (Hays, Stacy, & Dimatteo, 1987). While it is useful to create categories of risk/protective factors, it is necessary to explore the individual risk/protective factors associated with each category.

3. Risk and Protective Factors

A large number of studies have examined a wide variety of risk and protective factors for adolescent substance use. Generally, risk factors for adolescent substance use can be divided into three broad categories, including family factors, peer factors, and individual characteristics, although there is increasing evidence that the community environment may also play a role in influencing drug use. In contrast to risk factors, protective factors are individual, family, or environmental characteristics that reduce the likelihood of substance use.

Protective factors may include peer factors that enhance one's ability to resist adverse outcomes (Belcher & Shinitzky, 1998). Resiliency, or the ability of an individual to overcome negative life events, is the result of the protective factors present in an individual's life (Belcher & Shinitzky, 1998). High intelligence, low novelty-seeking behaviors, and avoidance of association with deviant peers are all associated with adolescent resiliency (Fergusson & Lynskey, 1996). Other characteristics that promote resistance to adolescent drug use include positive self-esteem, self-concept, self-control, assertiveness, social competence, academic

achievement, regular church attendance, and a sense of morality (Hawkins, Catalano, & Miller, 1992; Rhodes & Jason, 1990; Selnow & Crano, 1986; Wills, Vaccaro, & McNamara, 1992; Werner, 1986). As mentioned previously, positive family relationships appear to inhibit adolescent drug use initiation (Brook et al., 1986; Gorsuch & Butler, 1976; Jessor & Jessor, 1977; Norem-Hebeisen et al., 1984; Selnow, 1987). Brook et al. (1990) found that parents' traditional values (e.g., adolescent substance use is wrong) led to strong parent-child attachment. This mutual attachment led to internalization of traditional norms and behaviors by the children, which led the children to associate with non-drug-using peers, which led to abstinence (Brook et al., 1990). It has been suggested that shyness is also a protective factor, although shyness is associated with increased risk for substance use when combined with aggression (Fleming et al., 1982). However, Donovan (2004) has noted that the shyness measurement in the Woodlawn studies does not actually measure shyness, but can more accurately be described as a measure of having few friends. While it is important to consider protective factors, the majority of research focuses on the three broad categories of risk factors (family, peer, and individual characteristics) associated with adolescent substance use.

Family factors previously shown to be associated with adolescent substance use include both genetic and environmental components. Adoption studies have shown that adopted children whose biological parents were alcohol-dependent have a 2- to 9-fold increased risk of developing alcoholism, even when the adoptive parents are not alcoholics (Bohman et al., 1987; Cloninger, Bohman, & Sigvardsson, 1981; Goodwin et al., 1973, 1977; Hrubek & Omenn, 1981). Studies of siblings and twins born to drug dependent parents also show a genetic predisposition to both alcohol abuse and the abuse of other substances (Comings, 1997; Miller et al., 1989). Parental psychopathology, including parental substance abuse/dependence, maternal depression, and

maternal anxiety, has also been identified as a risk factor for substance abuse in their biological offspring (Cadoret et al., 1996; Merikangas et al., 1992; Pickens et al., 1991; von Sydow et al., 2002).

Prenatal substance exposure has more recently emerged as a predictor of offspring substance use and abuse. Prenatal alcohol exposure has been linked to subsequent alcohol use and abuse (Baer et al., 1998, 2003). Prenatal tobacco exposure has been shown to be associated with tobacco use (Buka, Shenassa, & Niaura, 2003; Cornelius et al., 2005; Kandel, Wu, & Davies, 1994). Finally, prenatal marijuana exposure has been shown to predict marijuana use (Day, Goldschmidt, & Thomas, in press; Porath & Fried, 2005).

Other family risk factors include parental beliefs and attitudes about substance use, parental tolerance of substance use, lack of closeness and attachment between parent and child, lack of parental involvement in the child's life, and lack of appropriate discipline and supervision (Baumrind, 1985; Kandel et al., 1978; Wechsler & Thum, 1973). Richardson, Dwyer, and McGuigan (1989) found that 8th graders who cared for themselves after school had a significantly higher risk for using alcohol, tobacco, and marijuana, and that the risk increased with longer duration of self-care. Chilcoat and Anthony (1996) confirmed these findings and found that children in the lowest quartile of parental monitoring initiated drug use at earlier ages than other children.

Poor family relationships have also been identified as risk factors for adolescent and early adulthood substance use problems. Children who have been abused, or who have witnessed violence, had a higher risk of drug and alcohol problems (Kilpatrick et al., 2000; Larkby et al., 2002). Children from homes where divorce was the result of marital discord are at higher risk of delinquency and drug use (Baumrind, 1985; Penning & Barnes, 1982; Robins, 1980). Family

structure itself appears to be less important than conflict among family members when predicting delinquent behavior in general (Farrington et al., 1985; McCord, 1979; Rutter & Giller, 1983). These findings have been extended to substance use in that the use of illegal drugs was found to be strongly associated with parental marital discord and stress, rather than with divorce (Baumrind, 1985; Hoffman, 1995; Simcha-Fagan, Gersten, & Langner, 1986). Lack of closeness between parents and a child, as well as lack of maternal involvement in their children's activities, appear to be related to drug use initiation (Braucht, Kirby, & Berry, 1978; Brook, Lukoff, & Whiteman, 1980; Kandel et al., 1978; Penning & Barnes, 1982). On the other hand, positive family relationships appear to function as a protective factor against drug use initiation. In summary, children from families with increased amounts of conflict, as well as those with low levels of bonding to their families, are at greater risk for delinquency, in general, and substance use, specifically (Hawkins, Catalano, & Miller, 1992).

Peer substance use (Brook et al., 1990; Johnston et al., 2004; Molina & Pelham, 2003) and association with peers who have favorable attitudes towards substance use predict onset and escalation of adolescent substance use (Barnes & Welte, 1986; Duncan et al., 1995; Ellickson & Hays, 1991; Kandel et al., 1978; Stice et al., 1998), as does perceived peer use (Jackson, 1997), although there is evidence that the effect of peers may be greater among Caucasian than African-American adolescents (Wallace, 1999). It has been hypothesized that peer cross-pressure, when peers disagree with an individual's decisions regarding substance use, may play a role in drug use initiation (Berelson & Steiner, 1964). Studies have shown that adolescents without psychological dysfunction are more likely to stop using drugs if their drug use is influenced by peer pressure (e.g., they stop their substance use when they stop associating with substance-using peers) (Kandel, 1975; Kandel & Logan, 1984; Kandel & Ravies, 1989). However, in the past

decade, investigators have begun to report that peer influence may be less significant than previously thought in predicting substance use or abuse (Dobkin et al., 1995; Glantz & Pickens, 1992; Ianotti et al., 1996; Masse & Tremblay, 1997). It has been suggested that previously reported individual and peer substance use associations may be due to substance-using peer selection by adolescent substance users, who project their own substance use into their reports regarding peers (Bauman & Ennett, 1994). However, there is still evidence that peer relationships, particularly early peer rejection, may be an important risk factor for substance use. Although Hawkins, Catalano, and Miller (1992) hesitate to acknowledge a direct link between early peer rejection and substance abuse, low peer acceptance has been associated with school problems and criminality (Coie, 1990; Kuperschmidt, Coie, & Dodge, 1990; Parker & Asher, 1987), which are also risk factors for substance use (Hawkins et al., 1987).

Individual characteristics define the third risk factor category. Gender is an individual characteristic found to be associated with risk for substance use. In adults, the prevalence rate of illicit drug use is twice as high among men as among women, with heavy alcohol use nearly three times higher in men (NIDA, 1995). These patterns of drug use between genders are found in adolescence as well. Boys generally use drugs more frequently than girls (Johnston et al., 1996; Johnston et al., 2004; O'Malley, Johnston, & Bachman, 1995).

Pubertal status, whether an individual matures early, on time, or late compared to their peers, has also been identified as a risk factor for substance use in early adolescence. In their study of 7th grade females, who were reassessed in 8th grade, Lanza and Collins (2002) found that during 7th grade, females in the early-maturing group were three times more likely to be in the more advanced stages of substance use, including alcohol use, drunkenness, cigarette use, and marijuana use, than their on-time/late developing peers. It was also shown that early

developers were more than twice as likely to initiate substance use between 7th and 8th grade than their on-time/late developing peers (47% vs. 22%) (Lanza & Collins, 2002). Tschann et al. (1994) found similar results in their cohort of 6th and 7th grade males and females, who were reassessed one year after the initial assessment. This study showed that early-maturing adolescents reported more substance use within one year than their on-time/late developing peers (Lanza & Collins, 2002).

There are also psychological predictors of substance use. Children who were more difficult, more withdrawn, antisocial, and under-controlled at seven years of age were more likely to be frequent substance users at adolescence (Shedler & Block, 1990). Externalizing behaviors (King et al., 2004; Molina & Pelham, 2003), depression (King et al., 2004), aggression (Brook, Nomura, & Chen, 1989), ego-resiliency (Block, Block, & Keyes, 1988), and conduct disorder (Boyle et al., 1993) are also precursors of substance use. Many of these separate measures have been grouped into a construct referred to as neurobehavioral disinhibition that refers collectively to behavioral undercontrol, emotional dysregulation, and executive functioning (Tarter et al., 2003).

Another individual factor that has been identified as a risk factor for adolescent substance use is school performance. School failure has been identified as a predictor of adolescent substance abuse (Jessor, 1976; Robins, 1980). Smith and Fogg (1978) found that poor school performance predicted frequency and levels of illegal drug use. In his longitudinal study, Holmberg (1985) found that in 15-year-olds, placement in special classes, early school drop out, and truancy predicted drug abuse, while Hundleby and Mercer (1987) found that outstanding school performance was associated with a decreased probability of frequent drug use among 9th graders. However, it is unclear when, developmentally, poor school performance becomes a

stable predictor of drug use, and evidence suggests that during the elementary grades, social adjustment may be a more important predictor of later drug use than academic performance (Hawkins, Catalano, & Miller, 1992). Feldhusen, Thurston, and Benning's (1973) findings that early antisocial behavior predicted both later academic failure and later drug use supports this conclusion. Academic failure later in elementary school may exacerbate the effects of early antisocial behavior or may independently contribute to drug abuse (Hawkins, Catalano, & Miller, 1992).

There is some evidence that the community environment may constitute an individual risk factor for adolescent substance use. Children aged 12 to 17 years are more likely to witness illegal drug sales in African American communities than in white or Hispanic communities (41.2% vs. 7.4% vs. 23.9%, respectively), and African American children are more likely to be exposed to intoxicated individuals than children of other ethnic groups (NIDA, 1995). One fact that makes the relationship between community and substance use questionable is that African American adolescents, who are more likely to be exposed to adverse communities, have a lower reported drug use rate than their white peers (Johnston et al., 2004; NIDA, 1995). However, Crum et al. (1996) examined disadvantaged neighborhoods in general, as opposed to neighborhoods defined by ethnic make-up, and found that youths living in the most disadvantaged areas were more than five times as likely to be offered cocaine than youths from more advantaged areas. Thus, it is possible that the influence is exerted through the disadvantaged neighborhood as opposed to the ethnic make-up of the community. This theory is consistent with the racial/ethnic differences observed among substance using adolescents.

As previously mentioned, substance use in adolescence is more prevalent in Caucasian and Hispanic than in African-American youths (Johnston et al., 2004). There also appears to be

a race by gender interaction, with Caucasian males having the highest rates and African-American females having lowest rates of substance use (Johnston et al., 2004).

Temperament and personality characteristics are also considered individual risk factors. While related, these two constructs are distinguished from one another based on the developmental stage of an individual. Thus, when predicting substance use during early adolescence, it is essential to understand the differences between temperament and personality.

B. TEMPERAMENT

1. Distinguishing Between Temperament and Personality

In much of the literature concerning temperament and personality, the two terms are often mistakenly used interchangeably. However, recent conceptions define temperament as biologically-rooted individual differences that appear in infancy, that are frequently but not exclusively emotional in nature, and that are related to formal characteristics of behavior (Cohen, 1999; Kagan, 1998; Rothbart & Bates, 1998; Shiner, 1998). Personality, on the other hand, is formed mainly by social processes, and develops gradually during childhood and adolescence (Strelau, 1983; Thomas & Chess, 1977). Thus, while temperament and personality are closely linked, they are conceptualized as separate constructs distinguished by the differences in the timing of their emergence in an individual's life. However, the two domains may not be as distinct as some would hope (McCrae et al., 2000), and the inability to distinguish between the two domains is consistent with the idea that temperament is a subset of personality (Matthews & Dreary, 1998; Shiner & Caspi, 2003), which is modified through interaction with the social environment to help form an individual's personality (Strelau, 1983; Thomas & Chess, 1977).

Personality traits and temperament traits have many factors in common. Many personality traits, like temperament traits, show moderate genetic influence (Bouchard & Loehlin, 2001). Emde & Hewitt (2001) have shown that temperament traits, like personality traits, are only partially heritable and are significantly influenced by unique pre- and postnatal environmental events. In addition, while temperament has been conceptualized as the part of personality that is present at birth, Rothbart, Ahadi, & Evans (2000) assert that not all temperament traits can be measured in infancy, as some aspects of temperament do not emerge until later in development (e.g., some emotions, motor skills, arousal and attention systems). Thus, while many are hesitant to claim that infants and young children have "personalities," the distinction between temperament and personality becomes increasingly unclear as children move out of infancy (Shiner & Caspi, 2003).

These findings suggest that the difference between temperament dimensions and personality traits is related to when they are assessed during development. Various developmental models of temperament formation indirectly support this model of temperament and subsequent personality development. These include the biosocial models of temperament (Lerner & Lerner, 1983; Thomas & Chess, 1977), which suggest that the environment influences and interacts with temperament development, as well as Bell's (1968) model which proposes bidirectional influences in parent-child interactions, and Sameroff's (1983) transactional model, which proposes that parental reactions and perceptions and infant temperament influence each other continuously over time.

2. History of Temperament and Psychopathology

Before Thomas and Chess began the New York Longitudinal Study (NYLS) in 1956, behavioral differences in children were mostly attributed to something in the environment, usually the mother's parenting skills (Chess & Thomas, 1996). This often led to unnecessary feelings of guilt and self-reproach in many young mothers, as they were blamed for any abnormalities in their children (Chess & Thomas, 1996). Thomas and Chess (1977) discredited this myth by showing that deviant development was the result of the interaction between temperament, "…significant features of the environment," and abilities and motives, the other two facets of individuality.

The results of the NYLS led the authors and their colleagues to suggest nine dimensions of temperament: activity levels, rhythmicity (regularity), approach/withdrawal, adaptability, threshold of responsiveness, intensity of reaction, quality of mood, distractibility, and attention span/persistence (Chess & Thomas, 1996). Based on the nine temperament dimensions, three temperamental constellations were formed; 1) "easy" group, characterized by mild or moderately intense positive mood, high adaptability, positive approach to new stimuli, and regularity of biological function, 2) the "slow-to-warm-up" group, characterized by mild intensity to new stimuli, regardless of whether mood is positive or negative, with slow adaptability after repeated contact, and 3) the "difficult" group, characterized by negative withdrawal responses to new stimuli, irregular biological function, low adaptability, and intense mood, which is often negative.

This longitudinal study was not without its limitations. The sample was composed of mostly healthy Caucasian middle- and upper-middle class families. The homogeneous nature of the group was deemed an advantage by the authors because a heterogeneous sociocultural group

would have introduced additional variables to complicate the ability to explore individual differences (Chess & Thomas, 1996). The generalizability of the NYLS findings was established by similar findings in an unskilled or semi-skilled working-class Puerto Rican group investigated separately (Chess & Thomas, 1996). Another limitation of the study was that temperament ratings were assessed solely by maternal reports. However, in their sample, maternal reports correlated significantly with the ratings of two objective observers (Chess & Thomas, 1996). This finding is not surprising as the mothers were not depressed or anxious, characteristics shown to influence maternal perception of child temperament (Cutrona & Troutman, 1986; Mebert, 1991; Sameroff et al., 1982; Vaughn et al., 1987; Ventura & Stevenson, 1986).

3. The Development of Temperament

While many models of temperament development have been proposed, the empirical literature on the stability of temperament measures indirectly supports the developmental models (Mednick et al., 1996a) by finding substantial temperament lability in infancy, followed by increasing stability and predictability during the second half of the second year (Lee & Bates, 1985; Matheny, Wilson, & Nuss, 1984; Pedlow et al, 1993). Support for the transactional model is also found in Katainen, Räikkönen, & Keltikangas-Järvinen's (1997) results indicating reciprocal effects in early childhood, where more negative temperament dimensions in the child were associated with more negative maternal factors (i.e., hostile childrearing) between ages three and six. Katainen, Räikkönen, & Keltikangas-Järvinen (1998) extended these findings into adolescence. They found that maternal childrearing attitudes interacted with child temperament during childhood, and affected the development of temperament from childhood to adolescence. These findings, however, relied exclusively on maternal ratings of child temperament, which are

prone to bias, as will be discussed later. The validity of the mothers' ratings was strengthened by the fact that maternal ratings predicted the child's self-rated temperament in adolescence.

4. Temperament Stability and Continuity from Infancy to Adulthood

The stability of temperament over time has been extensively studied over the past few decades. Reviews summarizing longitudinal research in this area show instability in infancy and early childhood, and increasing stability as individuals age. Temperament shows moderate (.3-.4) to substantial (.5-.8) stability in infancy and childhood (Buss & Plomin, 1984; Hubert et al., 1982; Lemery et al., 1999), better consistency in the toddler to preschool aged period than in infancy (Lemery et al., 1999), and increasing stability after age 3 (Thomas & Chess, 1982).

Unfortunately, the majority of the research conducted in this area has focused on the infancy and childhood periods, so less is known about the stability of temperament characteristics in late childhood and adolescence (Pesonen et al., 2003). Pesonen et al. (2003) attempted to address this issue by examining the continuity of temperament traits from maternal reports at ages 3-12 to self-reported temperament in adulthood (ages 20-29) using Buss & Plomin's temperament dimensions of emotionality, activity, and sociability. They found weak, but significant, stability for the individual temperament subscales that was lower in magnitude than in previous studies (Pesonen et al., 2003). Slabach, Morrow, and Wachs (1991) suggested that this decrease in stability was due to longer intervals between assessments. However, the decreased stability reported by Pesonen et al. (2003) may also have been a function of the change in reporters, from maternal reports in childhood, to self-reports in adulthood. Pesonen et al. (2003) also examined the stability of the "difficult temperament" construct and found its stability (0.2 - 0.31) to be higher than that of the individual subscales. Their findings support the

suggestion by Plomin and DeFries (1985) that aggregated temperament dimensions are likely to show higher stability than individual dimensions of temperament because they include more measures, and, subsequently, may be more reliable.

Roberts and DelVecchio (2000) also attempted to address the lack of data across the lifespan by performing a meta-analysis of the rank-order consistency (one indicator of stability) of personality traits from childhood to old age. Their results replicated the pattern of relative instability during infancy, and increasing stability with age (Roberts & DelVecchio, 2000). The stability of temperament traits increased in a step-like fashion from infancy to middle age. These step-like increases were found in the preschool years, in young adulthood, and again in middle adulthood, with a peak in stability being reached sometime after 50 years of age, at which point it plateaus, and remains steady (Roberts & DelVecchio, 2000). They also found that of the six most well-accepted temperament dimensions, approach, negative emotionality, task persistence, adaptability, and rhythmicity showed moderate levels of stability (.46-.52 after controlling for longitudinal study time intervals and sample age), while activity level showed somewhat less stability (.41). Finally, the responsiveness threshold dimension showed the lowest stability (.35), but this may, in part, be due to the small number of studies that have examined this dimension over time (Roberts & DelVecchio, 2000). Roberts and DelVecchio (2000) speculated why they may have underestimated the stability of the temperament dimensions examined in their meta-analysis. First, the use of different instruments at different ages may lead to the underestimation of stability. Also, due to the large number of studies included in the meta-analysis, the authors used the midpoints for each age range, instead of a continuous age variable to estimate the relationship between stability and age (Roberts & DelVecchio, 2000).

Like Pesonen et al. (2003), Korn (1984) examined the stability of difficult/easy temperaments from age one through young adulthood, with assessments at ages 1, 2, 3, 4, 5, 16-17, and 18-22. He found that difficult/easy temperament scores from ages 3 and 4 were the best childhood predictors of difficult/easy temperament in young adults, while temperament scores from ages 1, 2, and 5 had much poorer predictive value (Korn, 1984). Unfortunately, these data did not allow Korn (1984) to explore the possible reasons for the discontinuity.

The Fullerton Longitudinal Study (FLS) also examined the stability of "difficult temperament" traits, with slightly different results. These findings showed that four difficult temperament traits assessed at age 1.5, including fussy/difficult/demanding, unadaptable, unsociable behaviors, and resistance to control, showed significant and moderately high stability at least through mid-adolescence (r's= .61 to .64) (Guerin et al., 2003). These estimates may be more accurate than Korn's (1984), as the FLS assessed participants more frequently, with shorter time intervals between assessments: every six months from age one through age 3.5, and then yearly from ages 5 through 17 (Guerin et al., 2003). The FLS also provided evidence for systematic changes in parental reports of temperament as a function of the child's age (Guerin et al., 2003). Significant changes were observed in the mean ratings during the preschool and middle-childhood stages, but not during the adolescent period (Guerin et al., 2003). From ages 3 through 5, the preschool years, parents rated their children as becoming milder in intensity, as increasing in biological regularity, as having a positive mood more frequently, as having longer persistence/attention spans, and as becoming more perceptive and sensitive (Guerin et al., 2003). From ages 8 through 12, the middle childhood stage, parents rated their children as decreasing their activity levels, becoming more approachable to novel stimuli, becoming even more mild in intensity, and becoming less sensitive and perceptive (Guerin et al., 2003). Activity level and

approach showed the most consistent cross-time stability (Guerin et al., 2003). In summary, the four temperament dimensions measured in infancy correlated with temperament measured during the preschool, middle childhood, and adolescent years at a relatively stable and moderate level. Guerin et al. (2003) concluded that more temperament dimensions showed invariance in mean levels with increasing age, consistent with Roberts and DelVecchio's (2000) findings that temperament dimensions show increasing stability with age.

Since "difficult temperament" remains relatively stable from infancy through middle-adolescent years, it is appropriate to examine its usefulness as a predictor of substance use in early adolescence. However, in order to examine the relationship between substance use and difficult temperament characteristics, factors associated with difficult temperament must also be examined. This is necessary in order to determine if it is indeed difficult temperament characteristics that increase an adolescent's risk for substance use, or if it is the factors associated with difficult temperament that increase substance use risk.

5. Difficult Temperament and Associated Factors

According to Buss and Plomin (1984), children can be considered difficult on each of the four EAS scales. A difficult temperament is determined by scoring one standard deviation above the sample mean on the emotionality, activity, and shyness scales, and by scoring one standard deviation below the sample mean on the sociability scale. In recent decades, difficult temperament has been found to be associated with many factors.

In general, higher difficultness ratings have been associated with numerous maternal characteristics, including depression (Cutrona & Troutman, 1986; Gross et al., 1994; Mebert, 1991; Ventura & Stevenson, 1986), anxiety (Mebert, 1991; Sameroff et al., 1982; Vaughn et al.,

1987), and other dysfunctional maternal characteristics such as aggression, suspiciousness, impulsivity, dependency, external locus of control, fearfulness, introversion, and lower ability to cope with everyday problems (Bates & Bayles, 1984; Matheny, Wilson, & Thoben, 1987; Meares et al., 1982; Vaughn, Deinard, & Egeland, 1980). Mebert's (1991) findings that maternal depression and anxiety were related to difficult temperament ratings are biased due to the fact that temperament ratings were made exclusively through maternal reports. No independent observer ratings were used to determine if the difficult temperament ratings characterized the child's behavior. Vaughn et al. (1987) reported that compared to mothers of infants with easy temperaments, mothers of difficult infants were more anxious, suspicious, and impulsive, had lower levels of self-esteem, and were less likely to endorse positive statements about themselves. However, this study, like many of the studies examining maternal factors associated with difficult temperament, relied on maternal reports of infant temperament, which is subject to bias. The issue of how maternal characteristics influence their perceptions of their children's temperament is discussed in the methodological issues section. However, there are still a number of other factors associated with difficult temperament that are not affected by this bias.

A significant association between low SES and higher parental ratings of difficult temperament has been found in some studies (Prior et al., 1989; Sameroff et al., 1982), but not in others (Matheny et al., 1987; Maziade et al., 1984; Persson-Blennow & McNeil, 1981). Researchers have found that higher child-to-caregiver ratios and crowded living conditions are associated with mothers rating their infants as more difficult (Mullis, Mullis & Markstrom, 1987) and their toddlers as more intense and lower in adaptability and mood (Wachs, 1988). This suggests that increased pressure on mothers predicts higher difficultness ratings of their children (Mednick et al., 1996b).

Difficult temperament has also been correlated with several other factors in infancy, childhood, and adolescence. In infancy, difficult temperament has been associated with colic, night waking, and frequency of injury (Carey, 1972, 1974), and in first-born infants, it has been associated with withdrawal and sleeping problems in reaction to the birth of a sibling (Dunn, Kendrick, & MacNamee, 1981). Field et al. (1978) reported a negative correlation between difficult temperament and IQ in premature infants, but others have found no significant association between difficult temperament and Bayley (Bayley, 1969) developmental scores (Bates et al., 1982;Vaughn et al., 1981).

Difficult temperament dimensions have also been associated with behavior problems in childhood (Bates Maslin, & Frankel, 1985; Cameron, 1978; Caspi et al., 1995; Graham, Rutter, & George, 1973; McInerny & Chamberlin, 1978; Pettit & Bates, 1989; Prior et al., 1993; Thomas & Chess, 1977). Guerin, Gottfried, & Thomas (1997), using data from the Fullerton Longitudinal Study, found that the Infant Characteristics Questionnaire (ICQ) Difficulty factor, completed by mothers, was significantly and persistently correlated with annual parent reports of behavior problems from age 3.25 through age 12. ICQ Unadaptability showed similar correlations, although they were weaker than the associations with Difficulty, and the predictive value of Difficulty was slightly better for externalizing than for internalizing behavior problems (Guerin, Gottfried, & Thomas, 1997). They also noted that children who were rated as difficult at 1.5 years of age were more likely to exhibit behavior problem scores in the clinical range at ages 3.25 through 12 compared to children who were rated as not being difficult at 1.5 years of age.

Bussing et al. (2003) examined the relationship between attention deficit – hyperactivity disorder (ADHD), caregiver strain, and difficult temperament in a sample of children, average

age 10.3 years, at high risk for ADHD. Temperament was assessed by child self-report using the DOTS-R Child (Windle & Lerner, 1986). The "Difficult Temperament Index" measured six temperament dimensions including activity level, approach/withdrawal, adaptability, mood quality, rhythmicity, and task orientation (Bussing et al., 2003). All difficult temperament dimensions, except rhythmicity, were significantly correlated with Children's Depression Inventory (Kovacs, 1985) scores in this high-risk sample (Bussing et al., 2003). Maziade et al. (1985) demonstrated that children categorized as temperamentally difficult at age seven had more DSM-III diagnoses at age 12 than children with easy temperaments, including oppositional/defiant disorder (ODD) and attention deficit disorder (ADD) associated with an oppositional disorder. Maziade et al. (1985) also noted that the risk for psychiatric disorders was higher in children with difficult temperament in dysfunctional family situations than it was among difficult children in superior functioning families.

Difficult temperament has also been associated with psychiatric symptoms in adolescence. Lee et al. (2000) found that Chinese adolescents, aged 12-16 years, with two or more difficult factors had higher scores on self-rated psychiatric symptoms. Significant associations were noted between the temperament dimensions of intensity of reaction, adaptability, mood quality, rhythmicity, and approach/withdrawal and the psychiatric symptoms of somatization, depression, anxiety, hostility, phobia anxiety, paranoid ideation, psychoticism, and "other symptoms", although the correlations were weaker for rhythmicity and approach/withdrawal (Lee et al., 2000).

Both internalizing and externalizing problems in adolescence have also been shown to be associated with difficult temperament factors in early childhood (Caspi et al., 1995). Caspi et al. (1995) avoided the potential bias introduced by maternal reports of child temperament by using

independent observers' ratings of child temperament at ages 3, 5, 7, and 9. They found that three temperament dimensions, including lack of control, approach, and sluggishness, were related to teacher and parental reports of behavior problems at ages 9 and 11, and to parental reports of behavior problems at ages 13 and 15 in both boys and girls (Caspi et al., 1995).

6. Methodological Issues

Unfortunately, the techniques employed in the examination of individual differences, such as have just been described, are imperfect. Many different measures and scales have been used to describe individual differences in both children and adults, making it difficult to compare the results from various studies (Shiner & Caspi, 2003). Allport (1958) claimed that the integration of empirical findings would continue to be difficult as long as individual investigators used their own unique battery of diagnostic devices. Despite the fact that Allport made this observation nearly 50 years ago, it is still relevant today. However, there is potential to resolve this issue. As discussed previously, researchers have recently found that existing models of temperament and personality share many common traits (Angleitner & Ostendorf, 1994; Caspi, 1998; Church, 1994; Rothbart & Bates, 1998; Shiner, 1998; Shiner & Caspi, 2003; Watson, Clark, & Harkness, 1994). Shiner & Caspi (2003) believe that the recognition of a hierarchically organized personality -- with broad traits, the most general dimensions of individual differences, at the highest level, and specific traits, that are composed of more specific responses at successively lower levels (Eysenck, 1947; Hampson, John, & Goldberg, 1986; Kohnstamm et al., 1998) -- has assisted researchers in identifying similarities between broad dimensions of both temperament and personality. Prior (1992) noted that almost every model of temperament features the factors of sociability, emotionality, and activity in various forms, and therefore these

dimensions have considerable generality. Hopefully, as the similarities between disparate models of temperament, and of personality, are identified, the ability to integrate empirical findings will improve.

Another methodological issue, which has been debated in temperament research, involves the use of caregiver, usually maternal, reports of infant/child temperament. Research on parental perceptions of offspring temperament has evolved from initial thoughts that parental reports were objective reports on the child, to the more recent conclusion that parental reports involve social perceptions that reflect both objective child descriptions, as well as personality characteristics or mood of the parents (Bates, 1983). Much of the research on maternal perception of child temperament has been conducted with infants, so it is difficult to apply these findings to assessments of child and adolescent temperament.

One maternal characteristic that has been associated with maternal perception of infant temperament is depression. Maternal depression, before and after birth, has been related to higher maternal ratings of difficult temperament dimensions (Cutrona & Troutman, 1986; Mebert, 1991; Ventura & Stevenson, 1986). Whiffen (1989) concluded that maternal depression was associated with negative perceptions of the child and that the correlations over time between maternal depression and perceptions of difficult child temperament were statistically attributable to maternal mood at the time of assessment, as opposed to lifetime maternal depression ratings. Richters (1992) however, points out that children of depressed mothers may indeed have more problems than children of non-depressed mothers and therefore investigations into the "depression to distortion" phenomena must examine depression-related differences in mother-informant agreement, and not just the correlations between mother's depression and their ratings of children's behavior.

Prenatal maternal anxiety has also been associated with higher maternal ratings of difficult temperament dimensions (Mebert, 1991; Sameroff et al., 1982; Vaughn et al., 1987). However, with one exception (Mangelsdorf et al., 1990), postnatally measured maternal anxiety has not shown a statistically significant relationship with difficult temperament dimensions (Bates & Bayles, 1984; Daniels, Plomin, & Greenhalg, 1984; Ventura & Stevenson, 1986), although there is a trend, and the strength of the association increased for temperament ratings assessed at ages 24 months and older (Bates & Bayles, 1984; Daniels et al., 1984). Richter's (1992) comments about the "depression to distortion" phenomena can also be applied to the anxiety literature.

Many parent-report instruments have good internal psychometric properties of scale reliability and test-retest reliability (Buss & Plomin, 1975; Goldsmith, Reiser-Danner, & Briggs, 1991; Hubert et al., 1982; McDevitt & Carey, 1978; Rowe & Plomin, 1977). Lyon and Plomin (1981) found that parents do not project their own personality in their ratings of their children; however, other reports have shown poor correspondence between parental reports and direct observation (correlations range from .20-.40). Maternal and paternal ratings also show low correlations (0.50 range) (Jones & Parks, 1983; Lyon & Plomin, 1981), however, larger correlations between maternal and observer ratings were found when multiple parent reports were aggregated (Lyon & Plomin, 1981). Plomin and Foch (1980) however, found that while rater agreement for specific behavioral ratings based on counting or timing are high (0.90), agreement for global ratings of temperament characteristics which do not involve counting or timing are considerably lower (0.70). Viewed in this light, the agreement between mother and father ratings of broad dimensions of temperament begins to look more impressive (Lyon & Plomin, 1981).

Despite the potential bias associated with maternal reports of child temperament, information from parents can still be considered useful. Allen and Prior (1995) found that children rated as difficult by their mothers showed significantly more negative and argumentative behaviors when observed by raters blind to temperament classification. Similar findings about maternal reports lead Bates (1980; Bates & Bayles, 1984) to propose that parental reports of child temperament contain both an objective component (report of actual child behavior) and a subjective component (influenced by parent characteristics). Various studies have provided support for both the objective (Bates & Bayles, 1984; Matheny, Wilson, & Thoben, 1987; Mebert, 1991; Slabach, Morrow, & Wachs, 1991) and subjective (Bates & Bayles, 1984; Mebert, 1989, 1991; Sameroff, Seifer, & Elias, 1982; Vaughn et al., 1987) components of parental reports. Mednick et al. (1996a), however, note that according to the transactional approach, and consistent with the empirical findings of Crockenberg and Acredolo (1983), Hagekull and Bohlin (1986), and Mebert (1991), parents' early perceptions of child temperament (subjective component) may systematically influence parent-child transactions, and thus may be significant predictors of later, objectively observable child behavior. Mednick et al. (1996a) also noted that there is the possibility that maternal characteristics associated with measurement variance may be partially related to genetically transmitted, objectively observable child characteristics. Unfortunately, the majority of studies examining how maternal characteristics are related to maternal reports of their child's temperament do not compare the mother's ratings to the ratings of independent observers. Also, the majority of studies comparing maternal ratings to independent observer ratings do not examine which maternal characteristics may be associated with disparate ratings. Thus, the questions of how and why maternal

characteristics may influence their reports of their children's temperament, as well as their child's temperament itself, remain unanswered.

In addition to the previously mentioned support of the reliability of maternal reports, they are also useful for early identification and prevention. During infancy and childhood, someone other than the child needs to be able to recognize problems, and parents are often best suited for this, since they presumably know their child better than anyone else, and observe their children in many situations and across long stretches of time. Reports from objective third parties may be desirable, but the time needed to make observations can be prohibitive with large sample populations due to time and cost issues. It appears that the best way to minimize problems associated with maternal reports of child temperament is to use multiple informants whenever possible. The majority of studies examining the relationship between substance use and temperament, which are free of the bias associated with maternal temperament reports, have been conducted in adults. However imperfect they may be, all of these methods have been used in various ways to examine the relationship between temperament and substance use.

C. TEMPERAMENT AND SUBSTANCE USE

1. Relationship in Adults

Many studies have examined the temperament/substance use/substance use disorders relationship in adults. Hyperactivity in childhood has been shown to increase risk for later development of adult alcoholism and substance abuse (Kramer & Loney, 1981; Weiss & Hechtman, 1986; Biederman et al., 1998). McGue, Slutske, and Iacono (1999) found that if one controls for drug-use disorders, alcoholics have higher negative emotionality than non-

alcoholics, and if one controls for alcoholism, individuals with drug use disorders have lower levels of constraint than non-drug users. This study used broader descriptions of temperament dimensions, but could not assess of the direction of the effect.

2. Correlations in Adolescents

Numerous cross-sectional studies have been completed on adolescents. Tarter et al. (1990) found that 14- and 15-year-olds in an inpatient chemical dependency program scored higher than community controls on scales measuring general activity level, and lower on scales measuring flexibility, mood stability, eating rhythms, daily rhythms, and task orientation, and that disturbed behavioral activity regulation was associated with drug problem severity. However, this study was conducted on a clinical sample and is not readily generalizable to other populations.

Windle (1991) studied a mostly white sample of high school sophomores and juniors, and found that difficult temperament (measured using the DOTS-R) was significantly related to increased use of cigarettes, alcohol, and hard drugs, but not marijuana. The largest increase in substance use, particularly hard drugs, occurred between those with 4 or fewer difficult temperament factors and those with 5 or more difficult temperament factors. Molina, Chassin, and Curran (1994) examined the association between temperament and substance use in adolescents with and without an alcoholic parent. They found that negative affect was significantly related to substance use in both groups, and that sociability was directly and more strongly associated with substance use in adolescents with at least one biological, custodial alcoholic parent. The ethnic make-up of the sample was not discussed, and separate analyses were not performed for boys and girls.

Wills et al. (1994, 1995, 1998) completed a series of studies examining the relationship between temperament characteristics and substance use in adolescents. In summary, they found significant positive correlations between substance use and novelty seeking, risk orientation, independence orientation, and activity level. Significant inverse correlations were found between substance use and achievement orientation, mood, social anxiety, and order orientation. They concluded that the effects of temperament dimensions were mediated through other variables. Temperament related to constructs of good and poor self-control, which related to variables specified as more proximal to substance use onset: academic competence, negative life events, and deviant peer affiliations. Nevertheless, these cross-sectional studies could not establish the directionality of the relationship between temperament and substance use. In addition, these studies did not have a baseline temperament assessment to compare to current temperament.

Hyperactivity in childhood has been associated with substance use in adolescence, as well as adulthood. In their study of children with ADHD, Molina and Pelham (2003) found that children (ages 5-17) diagnosed with ADHD in elementary school had higher levels of alcohol, tobacco, and illicit drug use in adolescence than controls, and the severity of the childhood inattention problems predicted multiple substance use outcomes.

3. Longitudinal Studies of Temperament and Substance Use

Adult retrospective studies have shown that childhood conduct disorder and adult antisocial behavior were associated with adult substance abuse, and that childhood depression and inattention significantly predicted simultaneous alcohol and drug use (Ohannessian,

Stabenau, & Hesselbrock, 1995). However, these studies did not address childhood temperament as a predictor of later substance use problems.

The Dunedin Multidisciplinary Health and Development Study (Caspi et al., 1997; Krueger et al., 1996) is a longitudinal study that assessed a New Zealand birth cohort at ages 3, 5, 7, 9, 11, 13, 15, 18, and 21. Recent publications have examined the relationship between substance use disorders and age-3 temperament, age-15 symptom scales, age-18 personality, age-21 health-risk behaviors, and age-21 symptom scales. They found that substance-dependent and alcohol-dependent groups scored significantly lower on social closeness, control, harm avoidance, and traditionalism scales, and higher on stress reaction, aggression, and alienation scales than did controls. However, they found that age-3 temperament did not predict age-21 substance use once age-18 personality factors were entered into the model. This indicated that age 18 personality factors were mediators in the relationship between age 3 temperament and age 21 substance use. This study did not, however, address whether early temperament predicted adolescent substance use, particularly in middle adolescence.

Finally, a few studies have directly examined the effects of childhood temperament on adolescent substance use. Lerner and Vicary (1984) studied 133 middle-class children from the NYLS, and their use of alcohol, tobacco, and marijuana at ages 10-13, 13-16, 16-19, and over 19 years of age. They found that difficult temperament at age 5 and in adulthood significantly predicted all types of substance use in adulthood (age 19). However, none of the other known predictors of substance use were controlled for in this analysis. A study of low SES, white, French-speaking boys from Montreal (Dobkin et al., 1995; Masse & Tremblay, 1997) assessed the effects of disruptive kindergarten behavior, mutual friendship and peer ratings of aggressiveness and likability at ages 10, 11, and 12, and friends' deviance at age 13 on substance

abuse at age 13. They found that age-6 and age-10 novelty seeking and harm avoidance predicted later alcohol, drug, and cigarette use, and that characteristics in childhood (kindergarten disruptive behavior and peer-rated characteristics) were better predictors of early-onset substance abuse than friends' behavioral characteristics. These studies were conducted with an all-white, low SES group of boys, which makes it difficult to generalize the finding to other populations, particularly female populations. Another limitation is that there were no data on parent and family characteristics, nor information about the boys from either parent.

Other research has also examined the relationship between childhood temperament and later SUDs with a focus on the concept of difficult temperament. These traits have been conceptualized as indirect indicators of a genetic predisposition for SUDs, as these traits have been observed at higher levels in the biological offspring of males with substance use disorders (SUDs)(Tarter et al., 1999). Children with difficult temperament at age 11 and 12 have also been shown to use substances more frequently three years later, and to initiate substance use at earlier ages than their peers (Wills & Cleary, 1999). This relationship seems to be mediated by other factors, including cognitive distortions, family dysfunction, affiliation with deviant peers, and unconventional attitudes (Blackson & Tarter, 1994; Wills & Cleary, 1999).

D. LIMITATIONS

In summary, many of the studies of temperament and/or personality correlates of alcohol and other substance use utilize cross-sectional data, which cannot distinguish whether the temperament characteristics are antecedents or consequences of substance use. Many of the longitudinal studies do not have childhood measurements, so they also are unable to examine the

directionality of the relationship between temperament and substance use in adolescence. In addition, many studies focus only on a single substance, which leaves the question of whether the correlates are specific to that substance, or whether they reflect more general tendencies toward substance use. Finally, many measures of temperament do not use broad descriptions of temperament dimensions; rather they tend to use more individual profiles of personality.

The Maternal Health Practices and Child Development (MHPCD) Project, a longitudinal program of research on the effects of prenatal substance exposure, has a valuable and carefully collected data set. These data include measures of temperament using the EAS, which assesses emotionality, activity, sociability and shyness, as well as other variables that relate to the early onset of substance use, including family history of substance use and psychopathology, the adolescents' perception of peer drug use and its acceptability, child psychopathology and behavior characteristics, and parental monitoring practices. These data are available not only during the time period of the outcome of interest (early onset substance use – age 14), but also during ages when substance use is very rare (ages 6 & 10). These data can be used to assess the relationship between temperament at ages six and ten, and substance use at age 14.

E. STATEMENT OF PROBLEM

While many studies have examined the relationship between temperament characteristics and substance use, few longitudinal investigations have examined whether childhood temperament dimensions are useful in predicting later substance use outcomes, particularly in early adolescence. Identifying risk factors for adolescent substance use is particularly useful for prevention and intervention programs. While an individual's temperament cannot be altered, if it

is found that temperament characteristics in childhood predispose an individual to later substance use, prevention programs can be designed to help parents and children find more constructive ways to deal with individual temperament profiles. For instance, highly active children could be encouraged to participate in organized sports, children with high levels of negative emotions could be taught more effective coping skills at younger ages, and shy or unsociable children could be taught better social skills, and encouraged to socialize with non-deviant peers more effectively.

American adolescents initiate substance use at early ages: Reports of grade of first use in 8th graders from the Monitoring the Future study show that nearly 30% of the children initiate alcohol and cigarette use in 6th grade, when these children are 11 or 12 years old (O'Malley et al., 1999). It is necessary to make major efforts to delay, if not eliminate, these behaviors at such young ages, due to the serious consequences that can occur later in life, such as development of substance use disorders and the physical consequences of substance use. Questions of interest for this investigation are: does difficult temperament at ages 6 and 10 distinguish a high-risk group of adolescents who initiate substance use by age 14? Do children with difficult temperament initiate substance use at earlier ages than their less difficult peers?

F. SPECIFIC AIMS

The primary goal of this investigation was to examine whether temperament in childhood predicts the early onset of substance use in 14-year-olds, controlling for risk factors that have previously been shown to be associated with adolescent substance use, such as IQ, gender, prenatal substance exposure, and child psychopathology. This study examined whether

temperament characteristics at age 6 or at age 10 predict the onset of substance use, including alcohol, tobacco, and marijuana, by age 14. The secondary aims of this study included an examination of the variables that predict and/or are associated with substance use in the MHPCD cohort, whether the relationship between childhood temperament and substance use was moderated by race, gender, or pubertal status, as well as whether problem behaviors mediated this relationship.

III. METHODS

A. OBJECTIVES

The aims of this study were to examine the ability of childhood temperament to predict the early onset of substance use in 14 year olds, while controlling for a variety of risk and protective factors that have previously been associated with adolescent substance use. This study examined the direct effects of temperament at ages 6 and 10 on substance use at age 14, as well as whether the effects of childhood temperament on substance use were moderated by gender, race, and pubertal status, or mediated by problem behavior at age 10.

B. SPECIFIC AIMS AND HYPOTHESES

1. To examine whether temperament in childhood predicts substance use at age 14.

    H1: Temperament, measured at ages 6 and 10, will significantly predict substance use at 14 years of age.

    H2: Temperament, measured at ages 6 and 10, will distinguish between children who have not initiated substance use, those who have used a single substance, and those who have initiated use of multiple substances.

2. To identify specific environmental/demographic, child, and maternal variables that predict and/or are associated with substance use at age 14 in the MHPCD cohort, and how these variables affect the relationship between temperament and substance use.

    H3: Variables in the environmental/demographic domain, such as race, gender, SES, and the quality of the home, will be associated with substance use at age 14.

    H4: Variables in the child domain, such as delinquency, aggression, composite IQ score, depression, anxiety, and pubertal status, will be associated with substance use at age 14.

    H5: Variables in the maternal domain, such as prenatal substance exposure, use of physical discipline, maternal substance use, depression, and anxiety, will be associated with substance use at age 14.

    H6: The direct effect of temperament on substance use will remain when other characteristics of the child (gender, IQ), the mother (maternal substance use, maternal psychopathology, parenting practices), and the environment (demographic characteristics) are entered into the model.

3. To examine whether the effects of childhood temperament on substance use are moderated by gender, race, or pubertal status.

    H7: The relationship between temperament and substance use will be moderated by gender. For example, the relationship between childhood temperament and substance use at age 14 will be stronger for females than for males.

    H8: The relationship between temperament and substance use will be moderated by race. For example, the relationship between childhood temperament and substance use at age 14 will be different for whites than for non-whites.

    H9: The relationship between temperament and substance use will be moderated by pubertal status. For example, the relationship between childhood temperament and substance use at age 14 will be stronger for those who develop early than for those develop on-time or later.

4. To examine whether the effects of temperament are mediated by problem behavior and its relation to adolescent substance use outcomes at 14 years of age.

    H10: The relationship between temperament and substance use will be mediated by problem behaviors at age 10. That is, temperament at age 6 will predict problem behaviors at age 10, which in turn, will predict substance use at age 14.

C. DESIGN OF THE MATERNAL HEALTH PRACTICES AND CHILD DEVELOPMENT PROJECT

Data from the Maternal Health Practices and Child Development (MHPCD) Project were used for these analyses. The MHPCD Project is a longitudinal, epidemiological study of the effects of prenatal alcohol and/or marijuana exposure on the offspring. The MHPCD Project recruited women who were attending the Magee-Womens Hospital prenatal clinic. Informed consent was obtained from all participants before the initial interview. The Institutional Review Boards of the University of Pittsburgh and Magee-Womens Hospital approved the MHPCD Project. The Institutional Review Board of the University of Pittsburgh approved these secondary analyses.

Selection criteria included being 18 years of age or older, English speaking, and in the fourth month of pregnancy. All eligible women were asked to participate. Enrollment occurred from 1983 to 1985. The initial interview was conducted when the women came in for their fourth month prenatal visit. Women were contacted again at their fifth month visit if they were not interviewed the previous month. To ensure a consistent recall period for first trimester substance use, eligible women who did not complete the interview during their fourth or fifth month visits (Phase 1) were not contacted again. Fifteen percent of the eligible women refused to participate, with 1360 women being screened at Phase 1.

Two cohorts were selected from the screened sample. Women who reported consuming an average of three or more drinks per week in the first trimester, as well as a random sample of 1/3 of the women reporting less frequent alcohol consumption, or none at all, were selected for the alcohol cohort (n = 650; 78% of the sample of 829 in the combined cohort). All women who reported consumption of two or more joints per month during the first trimester, as well as a

random sample of 1/3 of the women using less or none, were selected for the marijuana cohort (n = 564; 68% of the sample of 829 in the combined cohort). Sampling was done with replacement so women could be in the alcohol cohort, the marijuana cohort, or both, with the overlap in the two cohorts equal to 47%.

Data collection has occurred across ten phases of the study. The fourth or fifth month interviews collected information about the year prior to, and the first trimester of, pregnancy (Phase 1). Interviews were conducted in a private setting in the prenatal clinic during Phase 1, and during the seventh month prenatal visit (Phase 2). Within 24 to 48 hours of delivery (Phase 3), women were interviewed in their hospital rooms, and their infants were given a physical exam by trained project nurses who were blind to prenatal substance use status. Subsequent maternal interviews and child assessments were conducted at a non-clinical, off-site location when the children were eight months (Phase 4), 18 months (Phase 5), 3 years (Phase 6), 6 years (Phase 7), 10 years (Phase 8), 14 years (Phase 9), and 16 years of age (Phase J).

The MHPCD Project has maintained high retention rates, with 88% of the birth cohort completing Phase 7 (age 6), 83% completing Phase 8 (age 10), and 76% completing Phase 9 (age 14) (Table 1). Women who did not complete assessments at one phase due to refusal, change of residence, or who were lost to follow-up remained eligible for the next phase of the study. No significant differences have been found between those interviewed at each phase and those not interviewed at Phases 3 to 6 with respect to demographic characteristics, prenatal substance use, or newborn status (Geva, Goldschmidt, Stoffer, & Day, 1993). There were no differences in maternal education, income, marital status, or prenatal alcohol and tobacco use between women who participated in the study at 14 years (n=580) and those who did not participate (n=183). However, women interviewed at the 14 year phase were more likely to be African-American

(55% vs. 42%, respectively) and were more likely to have used marijuana during the third trimester (20% vs. 11%) than those who did not participate.

Table 1. Follow-Up Rates for the MHPCD Cohort

PHASES	1	2	3	4	5	6	7	8	9
Child's Target age at Assessment	4 mos. prenatal	7 mos. prenatal	24-48 hours	8 mos.	18 mos.	3 yrs.	6 yrs.	10 yrs.	14 yrs.
Completed	829	730	763	595	649	672	668	636	580
Refused Current Phase		4	8	19	22	17	33	36	42
Refused Further Contact		-	-	-	-	-	2	8	10
Lost to Follow-up		60	16	123	48	18	8	25	69
Moved*		9	21	20	38	50	41	44	49
Temporary Foster Care			-	-	-	-	4	6	1
Child in Institution			-	-	-	-	-	-	3
Early Delivery		23							
Ineligible:**									
Twin		-	2	-	-	-	-	-	-
Miscarriage		2	-	-	-	-	-	-	-
Child Placed			1	3	3	3	3	3	3
Child Died		1	15	3	3	3	4	5	6
Completion Rate (% birth sample)				78%	85%	88%	88%	83%	

*Women who moved were considered ineligible only for the phase of their non-residence.
**Women in this category were dropped from all further follow-up.

D. VARIABLES INCLUDED IN ANALYSES

1. Outcome Measures

The decision of how to categorize substance use data from age 14 (Phase 9) required consideration of the advantages and disadvantages of the various possibilities. The Health Behavior Questionnaire (Jessor, Donovan, & Costa, 1989) was adapted for the MHPCD Project. The resulting Drug and Alcohol Questionnaire was administered to obtain substance use data

from the offspring. Versions of this instrument have been used to measure tobacco, alcohol, marijuana, and other drug use in six different studies involving over 25,000 adolescents between 1972 and 1992 (Donovan & Jessor, 1978, 1983, 1985; Donovan, Jessor, & Costa, 1991; Jessor, Chase, & Donovan, 1980; Jessor & Jessor, 1977). The Health Behavior Questionnaire has demonstrated construct validity, and consistently been shown to be related to a variety of psychosocial and behavior measures for over 20 years (Donovan, 1996; Donovan, Jessor, & Costa, 1999).

Substance use data were collected through interview when the children were 10, and they were asked to fill it out themselves at age 14. A great deal of research demonstrates the validity of self-report of substance use (Hancock et al., 1991; Martin, Wilkinson, & Bhushan, 1988; Pedersen, 1990). All adolescents were asked to provide a urine sample, and informed that it would be analyzed for his/her exposure to tobacco, alcohol, and marijuana. The samples served as biological validation of the adolescents' self-report of recent use, and as a bogus pipeline to convince the adolescents that all of their substance use could be determined from the sample. Use of a bogus pipeline procedure involves convincing participants that their self-reports can be independently verified by a bogus objective measure. In this case, the MHPCD did not inform participants that biological measures only cover a window of time; 24 hours for ethanol, and 48 hours for tetrahydrocannabinol (THC) and cotinine.

Analyses of the urine samples showed that the majority of children were honest about their substance use. Eleven children (1.9%) denied using cigarettes, but had adjusted cotinine levels > 50 ng/mg, a level that excludes the possibility that nicotine was consumed passively. For these analyses, these children were included as users where the substance use outcome was YES/NO, but were excluded from analyses where the level of cigarette use was the outcome of

interest. Only four children's (0.7%) self-report of marijuana use conflicted with the urine sample results. Again, these children were included in analyses with dichotomous substance use outcomes, and excluded when the outcome of interest was the frequency of marijuana use.

The misreporters differed from the rest of the sample on some of the covariates. ANOVAs comparing misreporters (n = 15) to the rest of the sample (n = 551) showed that misreporters were more likely to be male (47% vs. 87%, p = .003) and African-American (53% vs. 87%, p = .011), with higher delinquency scores on the Teacher Report Form (TRF; Achenbach, 1991b, mean = 56 vs. 64, p = .032). It should be noted however, that TRF scores were missing for four of the misreporters and for 206 of the rest of the sample. There were no differences on their delinquency scores from the Child Behavior Checklist (CBCL; Achenbach, 1991a), which was filled out by the mothers. The ANOVAs also showed trends for differences on the EAS Emotionality subscale from age 6 (2.75 vs. 3.11, p =.08) and the damage subscale of the Self-Report Anti-Social Behavior Scale (SRD; Loeber et al., 1989) (16% vs. 27%, p = .082), with misreporters having higher scores on each. Other covariates that showed no difference between misreporters and the rest of the sample were the EAS subscales at ages 6 and 10, current family income, current maternal substance use, and the status, theft, and violence subscales from the SRD.

The Drug and Alcohol Questionnaire provided information about the quantity and frequency of substance use for the last year. For these analyses, cigarette use was defined dichotomously (Table 2), ever vs. never smoked a cigarette, as well as by the following three groups: 1) no use, 2) non-regular use (< every day/almost every day), 3) regular use ($\geq$ every day/almost every day) (Table 3). Alcohol use was defined dichotomously, with yes indicating ever having tried more than a sip or taste of alcohol (Table 4), as well as by the following three

groups: 1) no use, 2) non-regular use (< 1 time/month), 3) regular use (≥ 1 time/month) (Table 5). These groups are based on the frequency of use within the past year. The use of marijuana at Phase 9 was defined dichotomously (Table 6), with yes indicating use within the past year, as well as by the frequency of marijuana use. Frequency was chosen for the marijuana measure because quantity consumed is difficult to measure accurately: There are various levels of potency available, marijuana is often shared with others, and it cannot be assumed that each individual consumes the same amount on any given occasion. For categorical analyses, marijuana use was defined by the following three groups: 1) no use, 2) non-regular use (< 1 time/month), 3) regular use (≥ 1 time/month) (Table 7).

Use of multiple substances was also examined in these analyses. Children were categorized into three groups: 1) abstainers (have not endorsed any use of any substance), 2) single substance users (have used only one substance), 3) polysubstance users (have used more than one substance) (Table 8).

Table 2. Dichotomous Cigarette Use

Group	n	%
Never Used	298	52.7
Ever Used	268	47.3

Table 3. Cigarette Categories Based on Frequency of Use

Group	n	%
No Use	298	54.0
Non-Regular Use	180	32.6
Regular Use	74	13.4

Non-regular use: < Every Day or Almost Every Day
Regular use: ≥ Every Day or Almost Every Day

Table 4. Dichotomous Alcohol Use

Group	n	%
Never Used	353	62.5
Ever Used	212	37.5

Table 5. Alcohol Categories Based on Frequency of Use

Group	n	%
No Use	367	65.2
Non-Regular Use	97	17.2
Regular Use	99	17.6

Non-regular use: < Once/Month
Regular use: ≥ Once/Month

Table 6. Dichotomous Marijuana Use

Group	n	%
Never Used	381	67.3
Ever Used	185	32.7

Table 7. Marijuana Categories Based on Frequency of Use

Group	n	%
No Use	393	69.9
Non-Regular Use	79	14.1
Regular Use	90	16.0

Non-regular use: < Once/Month
Regular use: ≥ Once/Month

Table 8. Polysubstance Use Groups

Group	n	%
Never Used Substances	220	38.9
Used 1 Substance	125	22.2
Used 2 or more Substances	220	38.9

2. Independent Variables

The Maternal Health Practices and Child Development Project data includes many variables related to adolescent substance use. The selected variables were organized into three domains: child, maternal, and environmental/demographic. Table 9 lists the variables by domain, indicating whether they are prenatal, childhood, or current measures, and at what ages the data were collected. Three predictors of adolescent substance use that were not included in these analyses include peer use, peer attitudes towards substance use, and parental monitoring practices. These data were excluded from this project because the intent was to examine

predictors, not concurrent risk factors, of substance use. The parental monitoring data were collected at age 14 (concurrent), but not at age 10. The peer data were collected at ages 10 and 14, but not enough children reported peer substance use, or peers' favorable attitudes towards substance use, to provide any meaningful information to this project.

Table 9. Variables Included in Analyses

Independent variables
Child Characteristics: temperament (ages 6 & 10), family history of alcohol/drug problems, composite IQ (ages 6 & 10), delinquency (age 10), aggression (ages 6 & 10), externalizing behaviors (age 6 & 10), depression/anxiety (age 6), depression (age 10), anxiety (age 10), pubertal status (age 14)
Maternal Characteristics: prenatal substance exposure (Phase 1), maternal substance use (ages 6 & 10), use of physical discipline (ages 6 & 10), depression (ages 6 & 10), anxiety (ages 6 & 10)
Environmental and Demographic Characteristics: (ages 6 & 10) race, gender, average family income, quality of the home environment
Dependent variables
Child's frequency of use of cigarettes, alcohol, and marijuana at Phase 9 (age 14), number of substances used by child (age 14)

a) Child Domain

(1) Temperament

The Emotionality, Activity, Sociability, and Shyness (EAS) Survey is a 20-item, 5-point Likert scale (never, rarely, sometimes, mostly, always) that the mothers completed at ages six and ten (Buss & Plomin, 1984). A copy of the EAS can be found in Appendix A. The mother is asked to rate her child's emotionality or distress, degree of activity, sociability, and shyness. Items include "My child tends to be shy"; "My child is very energetic"; "My child often fusses and cries"; "My child makes friends easily". The scale has adequate internal consistency (0.62 - 0.78) and test-retest reliability (Boer & Westenberg, 1994; Buss & Plomin, 1984; Gasman et al.,

2002; Mathiesen & Tambs, 1999; Rowe & Plomin, 1977). Due to the straightforward wording of the questions, the EAS was deemed appropriate for the lower education sample in the MHPCD Project.

The psychometric properties of the EAS have been examined in at least four separate analyses. All four studies showed that emotionality, activity and shyness were independent dimensions of temperament, regardless of age and gender (Boer & Westenberg, 1994; Gasman et al., 2002; Mathiesen & Tambs, 1999; Rowe & Plomin, 1977). The sociability scale has been shown to be related to both shyness and activity, however, three of the four confirmatory factor analyses supported a four-factor structure, since sociability cannot be equated to nonshyness (Boer & Westenberg, 1994; Mathiesen & Tambs, 1999; Rowe & Plomin, 1977). Cheek and Buss (1981) also provided support for distinct shyness and sociability factors. Gasman et al. (2002) felt that cultural differences and translation bias may have contributed to their alternate findings.

Cronbach's alphas were calculated for the EAS for this sample (see Appendix for EAS Survey). See Table 10 for original alphas. Based on inter-item correlations for each subscale, individual questions were selected for elimination. There were no obvious items to be eliminated in the Emotionality or Shyness subscales, and systematic elimination of each question did not improve the alphas for these subscales.

Table 10. Original Chronbach's Alphas for EAS

Subscale (all 5 questions in each subscale)	**Age 6**	**Age 10**
Emotionality (Qs 2, 6, 11, 15, 19)	0.78	0.78
Activity (Qs 4, 7, 9, 13, 17)	0.60	0.66
Sociability (Qs 3, 5, 10, 16, 18)	0.58	0.54
Shyness (Qs 1, 8, 12, 14, 20)	0.66	0.63

In the Activity subscale, inter-item correlations were lower for questions 7 and 17. Dropping question 7 alone increased the alpha at age 6 from 0.60 to 0.64 (Table 11). Dropping question 17 alone decreased the alpha at age 6 to 0.58. Dropping either question 7 or 17 at age 10 did not change the alpha by more than a couple thousandths of a point, but in order to maintain consistency with the age 6 measure, where question 7 was dropped, question 7 was also dropped from the Activity subscale at age 10.

In the Sociability subscale, correlations were lower for questions 10, 16, and 18, with question 18 having a negative correlation with question 16. Dropping question 18 resulted in an increase in the alpha at age 6 from 0.58 to 0.66 and an increase from 0.54 to 0.61 at age 10. The additional dropping of question 10 or 16 did not improve the alphas at either age, so question 18 was dropped from the age 6 and 10 Sociability subscales. See Table 11 for revised alphas for each subscale.

Table 11. First Revision of Chronbach's Alphas for EAS

Subscale	Age 6	Age 10
Emotionality (Qs 2, 6, 11, 15, 19)	0.78	0.78
Activity (Qs 4, 9, 13, 17)	0.64	0.66
Sociability (Qs 3, 5, 10, 16)	0.66	0.61
Shyness (Qs 1, 8, 12, 14, 20)	0.66	0.63

After the first revision of the EAS subscales based on the Cronbach's alphas, the omission of both questions 7 and 17 from the Activity subscale was examined, since the inter-item correlation was low for question 17 as well. Table 12 shows the second revision of the EAS Cronbach's alphas, with both questions 7 and 17 being dropped from the Activity subscale. Dropping question 17, in addition to question 7, increased the alphas at age 6 (.64 to .67) and age 10 (.66 to .71). Table 12 omits the Shyness subscale, which was dropped from these analyses based on the results of the factor analyses, which is discussed next.

Table 12. Second Revision of Chronbach's Alphas for EAS

Subscale	Age 6	Age 10
Emotionality (Qs 2, 6, 11, 15, 19)	0.78	0.78
Activity (Qs 4, 9, 13)	0.67	0.71
Sociability (Qs 3, 5, 10, 16) [a]	0.66	0.61

[a] If 18 & 10, or 18 & 16 dropped α = .64, .64 (age 6), α = .60, .59, respectively (age 10)

As there was still some question about the reliability of the EAS subscales, due to the lower than expected reliability coefficients, a factor analysis was performed on this sample. The factor analysis was performed in SPSS using the Principal Component Analysis option with varimax rotation. The factor analysis was performed two ways: 1) number of components unspecified, and 2) four factors forced.

The unspecified model created six components at ages 6 and 10. Component 1 included the five questions from the Emotionality subscale at ages 6 and 10 (Tables 13 & 14). Component 2 included three questions from the Activity subscale at ages 6 and 10. Components 3-6 were a mixture of the Sociability, Shyness, and the remaining Activity questions with no distinct pattern.

When four factors were forced, the results remained the same for Emotionality at 6 and 10, and Activity at 10 (Tables 15 & 16). At age 6, all five questions from the Activity subscale were included in one component. For the Sociability subscale, questions 3, 5, and 16 fit in one component, with question 10 fitting marginally well, based on an eigenvalue of .437. The questions from the Shyness subscale were scattered throughout the components, with some questions fitting equally well in multiple components.

Table 13. Results of Factor Analysis at age 6 (Number of Components Unspecified) [a]

Question (subscale)[b]	Component					
	1[c]	2[d]	3	4	5	6
1 (Shy)	.166	-.035	.064	.665	-.346	.313
2 (E)	.788	-.123	.022	.135	-.090	.061
3 (S)	.055	.155	.682	-.103	.346	.111
4 (A)	.102	.718	.202	-.076	.219	.040
5 (S)	.170	.153	.367	.057	.538	.385
6 (E)	.685	.055	.145	.029	-.110	.222
7 (A)	-.164	.238	-.027	-.066	.271	-.598
8 (Shy)	.128	-.100	-.727	.072	-.037	.064
9 (A)	.044	.726	.033	-.141	-.155	.140
10 (S)	-.124	.375	.331	-.238	.082	.506
11 (E)	.666	.154	-.296	-.017	-.068	.117
12 (Shy)	.071	-.304	-.635	.294	-.142	.072
13 (A)	.052	.748	.242	-.031	.216	-.155
14 (Shy)	.062	-.063	-.165	.789	-.067	-.053
15 (E)	.845	-.033	-.092	.023	-.026	-.083
16 (S)	-.128	-.110	.346	-.089	.697	-.029
17 (A)	-.125	.232	.030	-.049	.703	-.059
18 (S)	.198	.153	-.245	-.074	.186	.667
19 (E)	.579	.380	-.057	.023	.112	.090
20 (Shy)	-.018	-.159	-.193	.745	.148	-.198

[a] Eigenvalues of $\geq$ .5 fit well in a specified component, those > .4 fit marginally well. These values are highlighted.

[b] E – Emotionality, A – Activity, S – Sociability, Shy – Shyness.

[c] Emotionality

[d] Activity

Table 14. Results of Factor Analysis at age 10 (Number of Components Unspecified) [a]

Question (subscale)[b]	Component					
	1[c]	2[d]	3	4	5	6
1 (Shy)	.148	-.004	.171	-.242	.515	.527
2 (E)	.677	-.261	-.014	-.071	.220	.278
3 (S)	-.083	.263	-.504	.397	-.021	.213
4 (A)	.033	.657	-.263	.255	-.050	-.035
5 (S)	.095	.311	-.238	.568	-.129	.161
6 (E)	.748	.127	.107	-.035	-.030	.171
7 (A)	-.188	.260	-.055	.207	.150	-.668
8 (Shy)	.150	-.094	.722	-.173	.016	.091
9 (A)	.039	.788	-.057	.063	-.049	-.021
10 (S)	.023	.531	-.215	.135	-.277	.434
11 (E)	.671	-.098	-.017	-.090	-.096	.185
12 (Shy)	.034	-.267	.785	-.043	.233	.112
13 (A)	-.010	.602	-.507	.043	.019	-.244
14 (Shy)	.052	-.010	.053	-.166	.818	-.005
15 (E)	.826	-.010	.052	-.122	.077	-.092
16 (S)	-.190	-.045	-.369	.687	-.062	-.183
17 (A)	-.109	.153	.041	.805	-.030	-.123
18 (S)	.316	.202	.236	.173	-.057	.495
19 (E)	.656	.267	.143	.060	-.094	-.002
20 (Shy)	-.114	-.143	.075	.095	.754	-.169

[a] Eigenvalues of $\geq$ .5 fit well in a specified component, those > .4 fit marginally well. These values are highlighted.

[b] E – Emotionality, A – Activity, S – Sociability, Shy – Shyness.

[c] Emotionality

[d] Activity

Table 15. Results of Factor Analysis at age 6 (Four Components Forced) [a]

Question (subscale) [b]	Components			
	1 [c]	2 [d]	3	4 [e]
1 (Shy)	.378	-.023	.353	-.356
2 (E)	.719	-.050	.175	-.125
3 (S)	.046	.740	-.182	.144
4 (A)	.231	.319	-.256	.593
5 (S)	.272	.708	-.033	.050
6 (E)	.705	.078	-.059	-.090
7 (A)	-.337	-.008	.151	.589
8 (Shy)	.165	-.548	.188	-.051
9 (A)	.245	-.007	-.428	.446
10 (S)	.099	.437	-.533	.023
11 (E)	.685	-.251	-.008	.101
12 (Shy)	.108	-.528	.378	-.276
13 (A)	.128	.301	-.171	.710
14 (Shy)	.156	-.111	.697	-.087
15 (E)	.722	-.144	.149	.066
16 (S)	-.236	.659	.094	.117
17 (A)	-.144	.442	.088	.425
18 (S)	.437	.106	-.234	-.141
19 (E)	.630	.046	-.032	.316
20 (Shy)	-.012	-.048	.799	-.031

[a] Eigenvalues of $\geq$ .5 fit well in a specified component, those > .4 fit marginally well. These values are highlighted for subscales.
[b] E – Emotionality, A – Activity, S – Sociability, Shy – Shyness.
[c] Emotionality
[d] Sociability
[e] Activity

Table 16. Results of Factor Analysis at age 10 (Four Components Forced) [a]

Question (subscale) [b]	Components			
	1 [c]	2 [d]	3 [e]	4
1 (Shy)	.408	-.224	-.143	.390
2 (E)	.670	-.179	-.111	.169
3 (S)	-.035	.473	.421	-.099
4 (A)	.082	.646	.308	-.052
5 (S)	.139	.351	.592	-.162
6 (E)	.766	.037	-.037	-.036
7 (A)	-.397	.349	.141	.294
8 (Shy)	.276	-.565	-.199	.049
9 (A)	.158	.594	.159	-.044
10 (S)	.240	.424	.252	-.380
11 (E)	.641	-.043	-.124	-.116
12 (Shy)	.167	-.742	.002	.259
13 (A)	-.079	.816	.045	.037
14 (Shy)	.101	-.040	-.156	.796
15 (E)	.703	.043	-.192	.124
16 (S)	-.339	.246	.615	-.035
17 (A)	-.144	.097	.794	.019
18 (S)	.544	-.103	.270	-.137
19 (E)	.640	.141	.056	-.057
20 (Shy)	-.146	-.124	.067	.774

[a] Eigenvalues of $\geq$ .5 fit well in a specified component, those > .4 fit marginally well. These values are highlighted for subscales.
[b] E – Emotionality, A – Activity, S – Sociability, Shy – Shyness.
[c] Emotionality
[d] Activity
[e] Sociability

Based on the results of the factor analysis, as well as the Cronbach's alphas (Table 12), the Emotionality subscale for these analyses was composed of all five questions. The Activity subscale was composed of questions 4, 9, and 13, dropping questions 7 and 17. The Sociability subscale was composed of questions 3, 5, 10, and 16, dropping question 18. The Shyness subscale was not used for these analyses due to the poor results of the factor analysis and because shyness is not a major risk factor for substance use.

In order to examine the stability of temperament in this sample, correlations were calculated between each of the four subscales at age 6 and 10 (Table 17). All correlations were significant at the p = .01 level and ranged from 0.41 for Activity to 0.51 for Emotionality.

Table 17. Correlations Between Age 6 and Age 10 Temperament Measures

Temperament Subscale	Pearson Correlation *
Emotionality	.505
Activity	.412
Sociability	.449

*All significant at p < .01

(2) Family History of Substance Use Problems

Family history of substance use problems was obtained from the mother during the interview at ages 6 & 10. These questions included a history of alcohol or drug problems in the blood relatives of the biological mother and father, as well as a history of drug or alcohol problems of the male in the household, whether he was the biological father or not. Age 6 and 10 data were combined for the family history variable. The endorsement of a family history of alcohol/drug problems at any age was coded as 1. This variable was used dichotomously, with a 1 indicating presence of a problem in any blood relative of the child for family history data. The presence of a drug or alcohol problem in the man in the household was analyzed separately for age 6 and age 10, with a 1 indicating presence of a drug or alcohol problem in the man present in the household.

(3) Composite IQ Score

At ages six and ten, cognitive development was measured with the Fourth Edition of the Stanford-Binet Intelligence Scale (Thorndike, Hagen, & Sattler, 1986). While this standardized test provides scores for four areas, including verbal-reasoning, abstract-visual reasoning, quantitative-reasoning, and short-term memory, the composite IQ score has been found to be the

most reliable score, with a reliability coefficient of .96 for 6-year-olds, and .98 for 10-year-olds and 14-year-olds, and a test-retest reliability of .91 for 5-year-olds and .90 for 8-year-olds (Thorndike, Hagen, & Sattler, 1986). Therefore, the composite IQ score was used in these analyses due to its high reliability, as well as to maintain consistency with the current literature.

(4) Problem Behaviors

(a) Delinquency

The Self-Report Anti-Social Behavior Scale (SRD) was selected from the interview used in the Pittsburgh Youth Study (Loeber et al., 1989) to measure delinquency at age 10 in the MHPCD Project. The SRD was based on the National Youth Survey self-reported delinquency questionnaire (Elliot, Huizinga, & Ageton, 1985), and was revised for use with younger children (Loeber et al., 1989). The survey consists of 33 items asking the child about antisocial behaviors such as stealing, cheating, and purposefully damaging or breaking things. The SRD asks the children to report how many times in the past year they have engaged in delinquent behaviors such as cheating on tests, stealing, trespassing, carrying concealed weapons, damaging property, and physical violence. The SRD measures the presence or absence of five types of delinquent behavior, including theft, damage to property, violent behavior, selling illicit drugs, and status offenses, which are less serious, and include behaviors such as running away from home and cheating on a school test. The scores for the SRD at age 10 represent the number of offenses reported by the child in each category, and not the number of times they committed the offense. For example, seven items make up the status offense factor. Each time one of them is reported by the child, no matter how many times they committed an individual offense, it is counted as 1. The score of 0 or 1 for each item is usually added up to become the category score. For example, the status offense factor score ranges from 0 to 7. Due to the distribution of these offenses at age

10 in this sample, each type of offense was dichotomized to represent whether or not the child had engaged in status, theft, or damage offenses. As no children reported selling drugs at age 10, this subscale was dropped from these analyses. Also, because aggression was used as a separate covariate in these analyses, the violence subscale was dropped, since violence at age 10 consists mainly of aggressive behaviors, such as hitting family, friends, or teachers.

(b) Aggression

The Child Behavior Checklist (CBCL) was administered during the MHPCD Project assessments. The mother completed the CBCL at ages six and ten (Achenbach & Edelbrock, 1981). The CBCL consists of 118 behavior problem items and 20 social competence items, and can be divided into eight syndrome profiles including withdrawn, somatic complaints, anxious/depressed, social problems, thought problems, attention problems, delinquent behavior, and aggressive behavior. The mothers rate their child's behavior over the last six months. The test-retest and inter-interviewer reliability correlations for the CBCL have been reported to be in the .90's (Achenbach & Edelbrock, 1981). The raw scores from the CBCL aggression subscale were used continuously for these analyses.

(5) Child Psychiatric Symptoms

(a) Externalizing Behaviors

The CBCL was used to measure externalizing behavior at ages six and ten. For these analyses, the raw CBCL scores were used as continuous variables. Questions for externalizing behaviors include "Destroys his/her own things.", "Disobedient at home.", "Gets in many fights.", and "Screams a lot."

(b) Depression/Anxiety

The CBCL was used to measure a depression/anxiety score at age 6. The raw scores from the CBCL were used continuously in these analyses. Questions for depression/anxiety include "Withdrawn, doesn't get involved with others.", "Worrying.", "Fears going to school", and "Feels worthless or inferior."

(c) Depression

The Children's Depression Inventory (CDI) was adapted from the Beck Depression Inventory to assess depressive symptoms in children aged 8 to 17 years (Kovacs, 1992). This self-report instrument measures distress and general psychopathology rather than clinically-defined depression, and has satisfactory internal consistency and test-retest reliability (Kovacs 1992).

The CDI was administered at age 10. It consists of 27 items. Each item contains three statements and the children are asked to choose which statement of the three best reflects their feelings and ideas in the past two weeks. Each statement is associated with a score of 0, 1, or 2 (i.e. "I am sad once in a while. (0) I am sad many times. (1) I am sad all the time. (2)"). When the scores are summed, a higher score indicates more depressive symptoms. For these analyses, the CDI total score was used as a continuous variable.

(d) Anxiety

Anxiety was assessed at age 10 with the Revised Children's Manifest Anxiety Scale (RCMAS). The RCMAS is a 37-item self-report scale called "What I Think and Feel" and is appropriate for ages 6 to 19 years (Reynolds & Richmond, 1978). Twenty-eight dichotomous (YES/NO) items measure anxiety and nine items form a lie scale, a measure of the child's willingness to please. The total anxiety score ranges from 0 – 28. A higher score indicates a

greater level of anxiety. Children report whether each statement is true about them. Items include "I have trouble making up my mind"; "I like everyone I know"; "I always have good manners"; "I often worry about something bad happening to me". For these analyses, the RCMAS scores were used continuously.

(6) Pubertal Status

The Pubertal Development Scale (PDS, Petersen et al., 1988) is a reliable and valid self-report measure of pubertal status designed to collect the data in a non-intrusive manner. The PDS includes questions about the development of secondary sex characteristics in order to obtain data reflecting the sequence of pubertal development described by Tanner (1962). The child indicates whether the characteristics have not started, barely started, definitely started, been completed, or they don't know. Scores can be used as a continuous variable or grouped into five categories of pubertal status; pre-, early-, mid-, late-, or post-pubertal. There are separate forms for boys and girls. Sample items include "Have you noticed any skin changes, especially pimples?" "How about the growth of body hair? (Body hair means underarm and pubic hair)" for both boys and girls. The girls' forms include items such as "Have your breasts begun to grow?" "Have you begun to menstruate? (Have you had your period yet?)" Items for boys include "Have you noticed a deepening of your voice?" "Have you begun to grow hair on your face?"

For these analyses, a single item from the PDS was used to represent pubertal development. Children were asked whether they felt their development was much earlier, somewhat earlier, about the same, somewhat later, or much later relative to their peers. Since most children had not begun development by age 10, the data from the age 14 PDS assessment was used in these analyses. The use of this single item was deemed appropriate for these

analyses since the overall PDS score represents a child's developmental status at the time of the assessment, which was different for all the children.

b) Maternal Domain

(1) Prenatal Substance Use

Prenatal substance exposure data were obtained from the maternal interviews from Phase 1. In the fourth month of pregnancy, women reported their substance use for the year prior to pregnancy, and during the first trimester.

At the Phase 1 interview, women were given a calendar and asked to show when they conceived, when they realized they were pregnant, and when the pregnancy was confirmed by diagnostic tests. These dates were used to calculate a month-by-month rate of alcohol and marijuana use for the first trimester. For these analyses, first trimester alcohol and marijuana exposure were used as continuous variables. This was due to the small number of women who continued to use alcohol and marijuana during the second and third trimesters. First trimester cigarette exposure was also used, as women who smoked during the first trimester continued to smoke throughout pregnancy.

(2) Current Maternal Substance Use

The MHPCD Project designed the maternal substance use measures (Day & Robles, 1989). At the prenatal and birth visits, marijuana and alcohol use were measured for each month of the first, second, and third trimesters, retrospectively. Women reported consumption of wine, beer, liquor, wine and beer coolers separately. The type of substance, quantity, frequency, pattern, and mode of use were ascertained for marijuana, alcohol, and other illicit drugs. Maternal alcohol and marijuana use were expressed as the average number of drinks (ADV) or

joints (ADJ) per day, respectively. The cutpoint of ADV/ADJ > 0.89 is equivalent to one or more drinks/joints per day. This ADV/ADJ value was calculated using the following formula: (7 (drinks/joint)/week X 4 weeks/month)/31 days/month (Goldschmidt, Day, & Richardson, 2000). An ADV/ADJ of 0.4 is about three drinks/joints per week. Number and frequency of cigarettes was reported. At the 8- and 18-month and 3-year assessments, women reported use during the time since the last interview. At the 6- and 10-year assessments, women were asked to report use during the past year, and about changes in use since the last interview.

Marijuana and alcohol use were defined as continuous variables. The quantity and frequency were multiplied and then summed across the usual, maximum, and minimum estimates and expressed as average daily joints (ADJ) and average daily volume (ADV). Maternal tobacco use was expressed as the average number of cigarettes per day. Use of cocaine and use of other illegal substances were dichotomized as Yes/No. For the analyses concerning child substance use, maternal substance use at each phase was defined continuously for cigarettes, alcohol, and marijuana use, and dichotomously for cocaine and other illegal drug use.

(3) Physical Discipline

Maternal interviews at ages 6 and 10 asked about frequency and type of discipline practices. The HOME inventory (Caldwell & Bradley, 1984), which measures the quality and quantity of support for cognitive, social and emotional development available to the child within the home, was administered at ages 10 and 14. It also included items about discipline practices. It asked the mother to report (YES/NO) if they would ground, spank, talk to, assign chores to, ignore, send to room, rescind allowance or other privileges when their child swears or says “I hate you” during a temper tantrum, as well as how many times in the past week they have spanked, grounded, removed privileges, praised, removed allowance, shown physical affection

towards their child. This variable was used dichotomously, comparing mothers who used physical discipline to those who did not.

(4) Maternal Psychiatric Symptoms

(a) Depression

Maternal depression was evaluated using the Center for Epidemiologic Studies-Depression Scale CES-D (Radloff, 1977). The National Institute of Mental Health developed this self-report scale for use with general population samples. Subjects were asked to rate how often their feelings agree with each of the 20 items, on a 4-point scale ranging from 0 (never) to 3 (most of the time). The score is an unweighted sum of the 20 items. It measures levels of depressive symptomatology and a score of 16 or greater indicates possible depressive disorder.

The CES-D was used in the MHPCD Project because it has fewer somatic items than other scales, decreasing the potential of confounding by symptoms associated with pregnancy. The CES-D has a correlation of r = .90 with the Zung and of r = .81 with the Beck Depression Inventory. In community samples, the internal consistency of the CES-D was reported as $\alpha = .85$ (Radloff, 1977).

The CES-D addresses symptoms for a one-week period preceding administration. The reference time periods were changed for the MHPCD Project to include time since conception for the first interview, and time since the last interview for all subsequent phases. CES-D scores were used continuously in these analyses.

(b) Anxiety

Maternal anxiety was measured using the State-Trait Anxiety Inventory (STAI, Spielberger, Gorsuch, & Lushene, 1970). Each item in the STAI has a possible score of 1 (never) to 4 (almost all the time). The scores from each item are then summed. A higher score

indicates a higher number of symptoms. The stability of the STAI scales was assessed on male and female high school and college students for test-retest intervals ranging from one hour to 104 days, with the magnitude of the reliability coefficients decreasing as a function of interval length. Coefficients for the Trait-anxiety scale ranged from .65 to .86. Coefficients were lower for the State-anxiety scale, and ranged from .16 to .62, which was expected since responses are thought to reflect the influence of transient factors present at the time of testing. The correlations presented between the STAI and other measures of trait-anxiety, the Taylor Manifest Anxiety Scale, the IPAT Anxiety Scale, and the Multiple Affect Adjective Check List, were reported as .80, .75, and .52, respectively (Spielberger, Gorsuch, & Lushene, 1970). Maternal anxiety scores were used continuously in these analyses.

c) Environmental/Demographic Domain

(1) Race

At the first physical examination of the infants, study nurses recorded the child's race. Race was included due to racial differences in rates of adolescent substance use.

(2) Gender

At the first physical examination of the infants, study nurses recorded the child's gender. Gender was included due to gender differences in rates of adolescent substance use.

(3) Family Income

Average family income per month was reported at each interview.

(4) Quality of the Home Environment

At age six, the mothers completed the Home Screening Questionnaire (HSQ, Frankenburg & Coons, 1986) to screen the aspects of the child's home environment that have been demonstrated to correlate with cognitive development. The HSQ was designed for use in clinical settings in which parents have less than a high school education, and it correlates well with the HOME inventory. For children ages 3 – 6, the HSQ contains 34 questions and a 50-item toy checklist. The total possible score for this version of the HSQ is 56. A score of 41 or less indicates a "Suspect" household, which should be referred for additional evaluation, according to Frankenburg & Coons (1986). However, for these analyses, the total HSQ score was used as a continuous measure, with a higher score indicating a better quality of the home environment.

Since the MHPCD Project did not conduct home interviews, the HOME score used to assess the child's home environment at age 10 was based on the mother's report (Baker & Mott, 1989), which is an adaptation of the HOME Inventory (Bradley & Caldwell, 1979). In addition to the parenting practices items, the HOME Inventory includes items such as "About how many books does your child have?" "Is there a musical instrument that your child can use at home?" "Does your family get a daily newspaper?" "About how often does your whole family get together with friends or relatives?" All items include a YES/NO choice or a four- to five-point scale. For these analyses, the total HOME score was used continuously to indicate the quality of the children's home environment.

Inter-rater reliabilities for the HOME Inventory from numerous studies are reported to range from .80 to the low .90's (Bradley, Caldwell, & Elardo, 1981). As with the HSQ, the total

HOME score is coded as a continuous variable, with a higher score indicating a better quality home environment.

E. EXCLUSION CRITERIA

Some adolescents had medical conditions that interfered with their study performance, including cerebral palsy (n=2), fibrous dysplasia (n=1), mental retardation (n=7), Down's syndrome (n=1), visual impairment (n=1). Two adolescents had incomplete assessments. These 14 children were excluded from these analyses.

F. SAMPLE CHARACTERISTICS

All subsequent results are based on the 566 mother-child pairs assessed at age 14. Maternal and infant characteristics at birth (Phase 3) are described in Table 18. On average, mothers were 23 years of age at delivery, 46 % were Caucasian, and the majority of women reported family incomes less than $400/month. Approximately half of the live-born infants were male. The children's mean birth weight, gestational age, length, and head circumference were all within normal ranges.

Table 18. Sample Characteristics 24 – 48 Hours After Birth (Phase 3)

Maternal characteristics	**Phase 3 N = 566**
Mean age (years) (range)	23.1 (18 – 42)
Race (% Caucasian)	45.8 %
Average family income (per month)	$420
Male in Household (% present)	49 %
Marital Status (% married)	34.3 %
Participating in Work/School (% yes)	19 %
Education (yrs)	11.8 (7 - 18)
Parity (% primiparous)	43.8 %
Gravidity (% primigravida)	29.2 %
Infant characteristics	
Gender (% male)	48.4 %
Mean birth weight (lbs) mean (sd)	7.04 (1.26)
Mean gestational age (weeks) mean (sd)	39.8 (2.2)
Length (in)	19.4 (.98)
Head Circumference (mm)	341 (14.9)

Across Phases 7 – 9, as shown in Table 19, the increased ranges in ages of the mothers/caregivers reflect the fact that some children were no longer in the custody of their biological mothers. In these instances, the child was followed, and the parental information was collected from the caregiver. In addition, across the phases of interest to this study, increases were reported for average family income, education, percent married, and percent involved in work/school, while the percent of families with males present in the household decreased. The average weight, height, and composite IQ score of the children remained within normal ranges during Phases 7 – 9. The percent of children in the custody of their biological mother decreased over these eight years from approximately 97% to 89%.

Table 19. Sample Characteristics for Phases 7, 8, and 9

Maternal characteristics	**Phase 7 (6 yrs.)** N = 566	**Phase 8 (10 yrs.)** N = 566	**Phase 9 (14 yrs.)** N = 566
Mean age (years) (range)	30.4 (24 – 65)	35.4 (29 – 70)	39.2 (20 – 74)
Avg. family income (per mo.)	$1179 ($910)	$1486 ($1099)	$1923 ($1349)
Education (yrs)	12.2 (7 - 18)	12.2 (7 – 18)	12.5 (6 – 18)
Marital Status (% married)	35 %	40 %	43 %
Work/School Status (% yes)	67 %	64 %	76 %
Male in Household (% present)	53 %	54 %	53 %
Child characteristics			
Age (years) mean (range)	6.4 (5.5 – 8.99)	10.5 (9.9 to 12.5)	14.8 (13.9 – 16.2)
Weight (lbs) mean (sd)	23.0 (5.0)	91.7 (29.2)	146.4 (41.2)
Height (in) mean (sd)	46.9 (2.4)	56.6 (2.9)	65.2 (3.2)
Composite IQ Score mean (sd)	91.4 (13.9)	91.6 (11.5)	88.7 (14.5)
Grade mean (range)	3 (0 – 5)	5 (2 – 7)	9 (6 – 10)
Custody (% with bio. mom)	97.4%	93.3%	88.6%

G. POWER

Power analyses for this project were conducted with PASS software. For correlation analyses, a sample size of 566 achieves adequate power (> 80%) to reliably detect correlations as low as 0.13 using a two-sided hypothesis test with a significance level of 0.05. This sample size also achieves adequate power to detect a difference of 0.11 for a one-sided test. When splitting the sample to run separate analyses based on race and gender, there is adequate power to reliably detect an effect size of 0.23 among African-American females (N = 156), 0.24 among Caucasian females (N = 136), 0.23 among African-American males (N = 151), 0.26 among Caucasian males (N = 123), 0.17 among females (N = 292), 0.17 among males (N = 274), 0.17 among African-Americans (N = 307), and 0.17 among Caucasians (N = 259).

For logistic regressions, a sample size of 566 provides adequate (> 80%) power to detect an odds ratio of 1.3 for cigarette use and of 1.4 for alcohol and marijuana use in the entire

sample. When examining results by race and gender, there is adequate power to detect odds ratios of 1.7 for cigarettes and marijuana, and 1.8 for alcohol in African-American females (N = 156), and odds ratios of 1.7 for cigarettes and alcohol, and 1.8 for marijuana in Caucasian females (N = 136). There is also adequate power to detect odds ratios of 1.7 for cigarette and marijuana, and 1.9 for alcohol in African-American males (N = 151), and odds ratios of 1.8 for all substances in Caucasian males (N = 123). There is adequate power to detect odds ratios of 1.5 for all substances in females (N = 292), in males (N = 274), in African-Americans (N = 307), and in Caucasians (N = 259).

As there are currently no software packages equipped to evaluate power for polychotomous logistic regression, these analyses have not been performed. It should also be noted that while this study intended to include analyses based on difficult vs. non-difficult temperament characteristics, there was not sufficient power (approximately .60 for the full sample) to include these categorical analyses.

H. PLAN OF ANALYSIS

The SPSS software package was used for all analyses. To determine whether childhood temperament at age 6, or at age 10, predicted child substance use at age 14, Hypothesis 1 was addressed through logistic regression for the dichotomous outcomes, and through polychotomous logistic regression for the categorical outcomes. The substance use outcome for Hypothesis 2 was divided into three groups: 1) no use, 2) use of only one substance, and 3) use of more than one substance. Polychotomous logistic regression techniques were used to determine whether temperament was associated with use of multiple substances by age 14. However,

polychotomous logistic regression assumes a monotonic relationship for the independent variable among the outcome groups. In other words, polychotomous logistic regression assumes the means for the independent variables will consistently increase or decrease across the outcomes groups. Any variable that violated the monotonic assumption of polychotomous logistic regression was removed from the categorical analyses.

Hypotheses 3 - 5 were all addressed using similar methods. Bivariate logistic and polychotomous logistic regression analyses were conducted to identify the significant associations between the independent variables and child substance use status at age 14.

The variables found to be significant or marginally significant predictors of child substance use ($p \leq .10$) were then explored in a hierarchical manner, with race, gender, family history, and gestational exposures being evaluated first, followed by blocks of characteristics that were successively closer to current use. Each analysis was performed twice; the first time using child, maternal, and environmental variables from age 6, and the second time using child, maternal, and environmental variables from age 10. The order and contents of the blocks were: 1) race, gender, prenatal exposure and family history of drug problems; 2) maternal characteristics, such as psychological status; 3) home environment and parenting practices; 4) child characteristics, such as pubertal status, psychological status, and IQ; and 5) child problem behaviors, such as delinquency and aggression. To build the final age 6 and age 10 models, all variables with p-values < .10 in the hierarchical analyses were entered into each model by block to find the most parsimonious set of predictors.

Hypothesis 6 was addressed through logistic and polychotomous logistic regression techniques to determine if the direct effects of temperament remained after controlling for other relevant variables.

In order to determine whether the relationship between temperament and substance use was moderated by gender, race, or pubertal status, Hypotheses 7 - 9 were addressed through logistic and polychotomous logistic regression techniques. In addition to the main effects of temperament and gender, race, and pubertal status, the interaction terms, temperament x gender, temperament x race, and temperament x pubertal status, were added to the models, where appropriate.

Hypothesis 10 was addressed through regression techniques. Logistic and polychotomous logistic regression analyses were performed to assess whether temperament at age 6 predicted problem behaviors at age 10, such as aggression and delinquency, and whether these problem behaviors, in turn, predicted substance use at age 14. The potential mediation of the relationship between temperament and substance use by problem behaviors was first identified using Baron and Kenny's Causal Step test (Baron & Kenny, 1986; Judd & Kenny, 1981), which uses three steps to establish mediation; 1) show that X is associated with Y, 2) show that X is associated with M, 3) show that M is associated with Y, when controlling for X (where X = independent variable, Y = outcome variable, M = mediator). M completely mediates the relationship between X and Y when the effect of X on Y controlling for M is zero. When the effect of X decreases when controlling for M, but does not equal zero, M is considered a partial mediator of the relationship between X and Y.

There are limitations to the Baron and Kenny technique for evaluating mediation. First, this method does not allow for the estimation of the size of the indirect effect when there is partial mediation. Second, while this technique may be used to identify whether mediation is present, it does not provide a method for testing the significance of the indirect effect (Kenny, 2006a). Therefore, other techniques were employed to resolve these limitations.

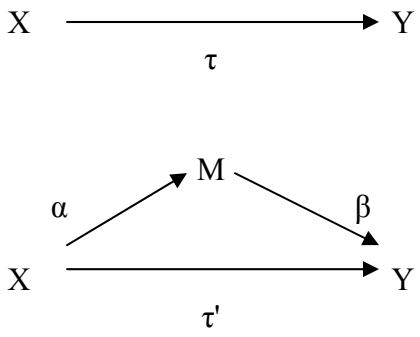

Figure 1. Direct Effect and Mediation Models

The indirect effect was estimated by the product of coefficients, αβ, where α = coefficient of X as a predictor of M, and β = coefficient of M predicting Y, controlling for X (Kenny, 2006a, see Figure 1). To test significance of the mediated effect, the estimate of the standard error of the estimated mediated effect was obtained by using Sobel's (1982)'s first order solution, where σ_α = the standard error of the coefficient of X as a predictor of M, and σ_β = the standard error of the coefficient of M predicting Y, controlling for X.

$$SE_{\text{Sobel}} = (\alpha^2 \sigma^2_\beta + \beta^2 \sigma^2_\alpha)^{1/2}$$

Sobel's test provides a Z-score, $z = \alpha\beta / SE_{\text{Sobel}}$, which indicates significance when compared to a critical value, $Z = \pm 1.96$, for $p = .05$. This test is recommended (MacKinnon et al., 2002), because it strikes a balance between power and Type I error rates. While it may have less power than some other methods reviewed in this paper, including the causal steps test (Baron & Kenny, 1986; Judd & Kenny, 1981), product of coefficients for standardized variables (Bobko & Rieck, 1980), and the second-order exact solution (Aroian, 1944), Sobel's test is balanced by more accurate Type I error rates than others reviewed (MacKinnon et al., 2002). However, methods of estimating mediation in ordinary least squares (OLS) regression do not directly apply in logistic regression. The variance in OLS linear regression is observed across

equations, while the variance of the residuals in logistic regression are fixed to $\pi^2/3$, and consequently, it depends on the extent of prediction, which depends on the variables in the model (MacKinnon & Dwyer, 1993).

One solution for estimating mediation in logistic regression is to make the scale equivalent across equations by standardizing regression coefficients prior to estimating mediation (Winship & Mare, 1983). This standardization can be achieved by dividing the coefficients by the standard deviations of the outcome variables in the corresponding equation. Also, the estimate of the standard error of the mediated effect should be standardized in the similar way. α and σ_α are divided by the square root of $(\alpha^2 \sigma_X^2 + \pi^2/3)$, and β and σ_β are divided by the square root of $(\tau'^2 \sigma_X^2 + \beta^2 \sigma_M^2 + 2\beta \tau' \sigma_{XM} + \pi^2/3)$, where σ_X = the standard deviation of X, σ_M = the standard deviation of M, and σ_{XM} = the covariance between X and M (Kenny, 2006b). Once the coefficients and the standard error of the mediated effect are standardized, Sobel's test can be performed.

There are other methods to estimate and test the significance of the mediated effect using regression techniques, but they were not appropriate for these analyses. One method, the Difference in Coefficients test (Freedman & Shatzkin, 1992), requires the correlation between the predictor and the mediator, or the r_{XM}^2 value. One of the weaknesses of logistic regression is that is does not provide a simple goodness of fit measure, like linear regression. An r^2 value assumes there is a linear relationship between two or more variables in a regression, and is the square of the correlation coefficient between the two variables. However, logistic regression operates on a logit-scale, and the underlying model is curvilinear. Therefore, a correlation coefficient is inappropriate, and there is no measure of "variance explained" that can be used to measure the goodness of fit in logistic regression.

Another method, the Asymmetrical Confidence Interval Test (MacKinnon & Lockwood, 2001), uses Meeker's (Meeker, Cornwell, & Aroian, 1981) tables, which are designed for two normally distributed variables. The delinquency variables in these analyses are dichotomous, so the use of Meeker's tables is not appropriate. Therefore, the use of Sobel's test, calculated with standardized coefficients, was deemed the most appropriate way to test mediation in these analyses because it is highly recommended for its balance between power and Type 1 error rates (MacKinnon et al., 2002), and because other popular methods were not appropriate for the conditions present in these analyses.

IV. RESULTS

A. DESCRIPTIVE STATISTICS

Tables 20 – 33 list descriptive statistics for all covariates for each substance use outcome group. ANOVAS and χ^2 tests were conducted for continuous and dichotomous variables, respectively, to test for significant differences between groups. For dichotomous cigarette groups, gender, race, prenatal and current maternal cigarette use, maternal depression, maternal anxiety at child's age 6, child's externalizing behaviors and aggression, all temperament measures at age 6, and status and theft offenses at age 10 had p-values < .10 (Tables 20 & 21).

For categorical cigarette groups, gender, race, prenatal and current maternal cigarette use, maternal use of other drugs when their child was 6 years old, maternal depression, child's externalizing behavior and aggression, sociability at age 6, and child depression, status, and theft offenses at age 10 had p-values < .10 (Tables 22 & 23).

For dichotomous alcohol groups, race, prenatal and current maternal cigarette use, maternal use of other drugs when their child was 10 years old, family income at age 10, quality of the home environment, child IQ, externalizing behaviors, aggression, and child depression, status and theft offenses at age 10 had p-values < .10 (Tables 24 & 25).

For categorical alcohol groups, gender, race, prenatal and current maternal cigarette use, maternal anxiety at child's age 6, family income, quality of the home environment, child IQ and

aggression, child externalizing behaviors at age 6, and status and theft offenses at age 10 had p-values < .10 (Tables 26 & 27).

For dichotomous marijuana groups, prenatal cigarette, alcohol, and marijuana exposure, current maternal cigarette use, maternal alcohol and other drug use at child's age 6, maternal marijuana use when their child was 10 years old, maternal cocaine use, maternal depression at child's age 10, family income, quality of the home environment, drug/alcohol problems in the man in the household when the child was 10 years old, child externalizing behaviors and aggression, and status and theft offenses at age 10 had p-values < .10 (Tables 28 & 29).

For categorical marijuana groups, prenatal cigarette, alcohol, and marijuana exposure, current maternal cigarette use and depression, maternal cocaine use at child's age 10, family income, quality of the home environment, physical discipline at age 6, child IQ, externalizing behaviors, aggression, and child depression, status, theft, and damage offenses at age 10 had p-values < .10 (Tables 30 & 31).

For polysubstance use groups, race, prenatal and current maternal cigarette use, prenatal marijuana exposure, family income at age 10, family history, drug/alcohol problems in the man in the household at age 6, child externalizing behaviors and aggression, sociability at age 6, and status and theft offenses at age 10 had p-values < .10 (Tables 32 & 33).

Table 20. Prenatal and Age 6 Descriptive Statistics for Dichotomous Cigarette Outcomes

Variables	Never Use		Ever Use		Comparison Statistics		
	N = 298		N = 268				
	Mean	sd	Mean	sd	χ^2	F	p
Demographic Variables							
Child's Age	6.4	0.4	6.5	0.5		.849	.357
Gender (% male)	52.7%	-	43.7%	-	4.605		.032**
Race (% Caucasian)	37.6%	-	54.9%	-	16.949		.000**
Prenatal Variables							
Cigarette (cig/day)	6.8	10.3	9.1	11.7		6.172	.013**
Alcohol (ADV)	0.5	1.1	0.6	1.5		.291	.590
Marijuana (ADJ)	0.4	1.0	0.4	1.0		.028	.867
Cocaine (% use)	3.0%	-	3.4%	-	.052		.819
Other Drugs (% use)	8.1%	-	10.1%	-	.703		.402
Maternal Variables							
Cigarettes (cig/day)	7.8	10.4	11.2	11.8		12.463	.000**
Alcohol (ADV)	0.9	1.6	1.1	2.5		.939	.333
Marijuana (ADJ)	0.2	1.0	0.1	0.6		.135	.714
Cocaine (% use)	8.2%	-	9.5%	-	.266		.606
Other Drug (% use)	5.7%	-	5.5%	-	.008		.927
Depression (CES-D)	37.0	9.7	38.8	9.5		4.266	.039**
Anxiety (STAI)	16.2	4.5	17.0	4.6		3.617	.058*
Environmental Variables							
Family Income (avg. $/mo.)	1155	947	1206	868		.416	.519
Home Environment (HSQ)	40.0	5.8	39.7	6.2		.257	.612
Man in House Alcohol/Drug Problems (% yes)	15.0%	-	15.7%	-	.027		.868
Physical Discipline (% yes)	34.5%	-	31.9%	-	.416		.519
Child Variables							
Family History (% yes)	79.9%	-	84%	-	1.472		.225
Depression/Anxiety (CBCL)	3.2	3.1	3.6	3.7		2.459	.117
IQ (Stanford – Binet)	91.5	14.0	91.1	13.7		.186	.667
Ext. Behaviors (CBCL)	10.4	7.3	12.3	7.8		8.123	.005**
Aggression (CBCL)	8.5	6.2	9.9	6.4		6.148	.013
Emotionality (EAS)	2.7	0.7	2.8	0.7		3.418	.065*
Activity (EAS)	3.7	0.8	3.9	0.8		4.822	.029**
Sociability (EAS)	3.8	0.7	4.0	0.6		9.045	.003**

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

* $p < .10$

** $p \leq .05$

Table 21. Age 10 Descriptive Statistics for Dichotomous Cigarette Outcomes

Variables	Never Use		Ever Use		Comparison Statistics		
	N = 298		N = 268				
	Mean	sd	Mean	sd	χ^2	F	p
Demographic Variables							
Child's Age	10.5	0.5	10.5	0.5		.295	.587
Gender (% male)	52.7%	-	43.7%	-	4.605		.032**
Race (% Caucasian)	37.6%	-	54.9%	-	16.949		.000**
Maternal Variables							
Cigarettes (cig/day)	7.8	10.1	11.5	11.7		14.963	.000**
Alcohol (ADV)	1.1	2.4	1.2	3.7		.098	.754
Marijuana (ADJ)	0.1	0.4	0.1	0.3		.188	.665
Cocaine (% use)	6.5%	-	7.1%	-	.085		.770
Other Drug (% use)	2.2%	-	2.8%	-	.205		.651
Depression (CES-D)	37.1	9.2	39.0	9.8		5.228	.023**
Anxiety (STAI)	16.5	4.4	16.8	5.0		.489	.458
Environmental Variables							
Family Income (avg. $/mo.)	1449	1027	1527	1173		.675	.412
Home Environment (HOME)	12.8	2.6	12.6	2.8		.753	.386
Male in House Alcohol/Drug Problems (% yes)	14.2%	-	12.7%	-	.136		.712
Physical Discipline (% yes)	18.6%	-	21.7%	-	.754		.385
Child Variables							
Depression (CDI)	45.4	8.4	47.0	8.7		4.661	.031**
Anxiety (RMCAS)	9.6	6.1	10.6	6.2		3.453	.064*
IQ (Stanford – Binet)	91.4	11.3	91.8	11.8		.145	.704
Pubertal Status (PDS)	3.0	0.9	3.1	0.9		.448	.503
Ext. Behaviors (CBCL)	10.0	7.0	11.7	7.8		6.918	.009**
Aggression (CBCL)	8.2	5.7	9.2	6.0		4.243	.040**
Status Offense (% yes)	17.9%	-	25.2%	-	4.186		.041**
Theft Offense (% yes)	14.3%	-	23.6%	-	7.521		.006**
Damage Offense (% yes)	15.4%	-	17.3%	-	.355		.551
Emotionality (EAS)	2.6	0.7	2.6	0.7		.515	.473
Activity (EAS)	3.6	0.8	3.6	0.8		.716	.398
Sociability (EAS)	3.7	0.6	3.8	0.6		2.030	.155

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

* $p < .10$

** $p \leq .05$

Table 22. Prenatal and Age 6 Descriptive Statistics for Categorical Cigarette Outcomes

Variables	No Use		Non-Reg. [a]		Regular Use [b]		Comparison Statistics		
	N = 298		N = 180		N = 74				
	Mean	sd	Mean	sd	Mean	sd	χ^2	F	p
Demo. Variables									
Child's Age	6.4	0.4	6.4	0.4	6.6	0.5		2.145	.118
Gender (% male)	52.7%	-	43.9%	-	36.5%	-	7.746		.021**
Race (% Caucasian)	37.6%	-	46.7%	-	78.4%	-	39.759		.000**
Prenatal Variables									
Cigarettes (cig/day)	6.8	10.3	7.5	10.8	12.5	12.7		8.260	.000**
Alcohol (ADV)	0.5	1.1	0.5	0.9	0.7	1.0		.929	.395
Marijuana (ADJ)	0.4	1.0	0.4	1.0	0.3	0.8		.328	.721
Cocaine (% use)	3.0%	-	2.8%	-	5.4%	-	1.267		.531
Other Drg (% use)	8.1%	-	10.0%	-	12.2%	-	1.378		.502
Maternal Variables									
Cigarette (cig/day)	7.8	10.4	9.9	11.3	15.1	12.6		12.045	.000**
Alcohol (ADV)	0.9	1.6	0.9	1.7	1.2	2.6		.564	.569
Marijuana (ADJ)	0.2	1.0	0.1	0.5	0.2	0.7		.170	.844
Cocaine (% use)	8.2%	-	9.2%	-	7.3%	-	.144		.930
Other Drug (% use)	5.7%	-	2.9%	-	4.4%	-	7.405		.025**
Depression (CES-D)	37.0	9.7	38.1	9.2	39.8	9.9		2.423	.090*
Anxiety (STAI)	16.2	4.5	16.8	4.5	17.3	4.9		1.797	.167
Env. Variables									
Family Inc (avg. $ /mo)	1155	947	1221	911	1117	731		.425	.654
Home Env. (HSQ)	40.0	5.8	39.6	6.3	40.3	6.2		.392	.676
Male in House Alc/Drug Prob. (% y)	15%	-	15%	-	21.1%	-	.844		.656
Phys. Disc. (% yes)	34.5%	-	32.2%	-	27.9%	-	1.132		.568
Child Variables									
Family History (% y)	79.9%	-	83.0%	-	83.6%	-	.915		.633
Dep./Anx. (CBCL)	3.2	3.1	3.5	3.6	4.1	4.2		2.156	.117
IQ (Stanford – Binet)	91.2	14.0	91.3	13.8	91.3	13.3		.049	.953
Ext. Behav. (CBCL)	10.5	7.3	11.7	7.4	13.3	8.5		4.262	.015**
Aggression (CBCL)	8.5	6.2	9.4	6.2	10.5	7.0		2.957	.053*
Emotionality (EAS)	2.7	0.7	2.8	0.7	2.8	0.8		1.534	.217
Activity (EAS)	3.7	0.8	3.9	0.8	3.9	0.7		2.180	.114
Sociability (EAS)	3.8	0.7	4.0	0.6	4.0	0.5		5.357	.005**

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

[a] Non-regular use < every/almost every day

[b] Regular use $\geq$ every/almost every day

* $p < .10$

** $p \leq .05$

Table 23. Age 10 Descriptive Statistics for Categorical Cigarette Outcomes

Variables	No Use		Non-Reg. [a]		Regular Use[b]		Comparison Statistics		
	N = 298		N = 180		N = 74				
	Mean	sd	Mean	sd	Mean	sd	χ^2	F	p
Demo. Variables									
Child's Age	10.5	0.5	10.5	0.5	10.6	0.6		.920	.399
Gender (% male)	52.7%	-	43.9%	-	36.5%	-	7.746		.021**
Race (% Caucasian)	37.6%	-	46.7%	-	78.4%	-	39.759		.000**
Maternal Variables									
Cigarette (cig/day)	7.8	10.1	9.7	11.1	15.5	12.5		14.192	.000**
Alcohol (ADV)	1.1	2.4	1.1	4.1	1.1	2.4		.024	.976
Marijuana (ADJ)	0.1	0.4	0.1	0.3	0.04	0.1		.744	.476
Cocaine (% use)	6.5%	-	7.0%	-	7.3%	-	.080		.961
Other Drug (% use)	2.2%	-	2.3%	-	4.4%	-	1.128		.569
Depression (CES-D)	37.1	9.2	38.2	9.4	40.8	10.6		4.360	.013**
Anxiety (STAI)	16.5	4.4	16.5	4.9	17.6	5.3		1.670	.189
Env. Variables									
Family Inc. (avg. $/mo.)	1449	1027	1579	1230	1444	1088		.799	.450
Home Env. (HOME)	12.8	2.6	12.6	2.8	12.6	2.9		.179	.836
Male in House Alc/Drug Prob. (% y)	14.2%	-	12.2%	-	13.5%	-	.186		.911
Phys. Disc. (% yes)	18.6%	-	23.3%	-	18.8%	-	1.498		.473
Child Variables									
Depression (CDI)	45.4	8.4	38.2	9.4	49.2	10.1		5.553	.004**
Anxiety (RMCAS)	9.6	6.1	16.5	4.9	11.2	6.7		1.996	.137
IQ (Stanford – Binet)	91.4	11.3	92.2	11.8	91.5	12.0		.296	.744
Pubertal Status (PDS)	3.0	0.9	3.1	0.9	2.5	0.8		.533	.587
Ext. Behav. (CBCL)	10.0	7.0	11.3	7.6	12.6	8.7		3.876	.021**
Aggression (CBCL)	8.5	6.2	8.9	5.9	9.8	6.4		2.446	.088*
Status Off. (% yes)	17.9%	-	25%	-	29.0%	-	5.597		.061*
Theft Off. (% yes)	14.3%	-	25.6%	-	21.7%	-	9.105		.011**
Damage Off. (% yes)	15.4%	-	16.3%	-	17.4%	-	.181		.914
Emotionality (EAS)	2.6	0.7	2.8	0.7	2.7	0.6		.576	.563
Activity (EAS)	3.6	0.8	3.9	0.8	3.7	0.8		.623	.537
Sociability (EAS)	3.7	0.6	4.0	0.6	3.8	0.6		1.197	.303

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

[a] Non-regular use < every/almost every day

[b] Regular use $\geq$ every/almost every day

* $p < .10$

** $p \leq .05$

Table 24. Prenatal and Age 6 Descriptive Statistics for Dichotomous Alcohol Outcomes

Variables	Never Use		Ever Use		Comparison Statistics		
	N = 353		N = 212				
	Mean	sd	Mean	sd	χ^2	F	p
Demographic Variables							
Child's Age	6.4	0.4	6.5	0.5		1.790	.182
Gender (% male)	51.0%	-	43.9%	-	2.692		.101
Race (% Caucasian)	36.5%	-	61.3%	-	32.751		.000**
Prenatal Variables							
Cigarette (cig/day)	6.8	10.2	9.6	12.2		8.916	.003**
Alcohol (ADV)	0.6	1.5	0.6	1.0		.027	.869
Marijuana (ADJ)	0.4	1.0	0.4	1.0		.170	.680
Cocaine (% use)	2.5%	-	4.3%	-	1.235		.266
Other Drugs (% use)	8.5%	-	9.9%	-	.319		.572
Maternal Variables							
Cigarettes (cig/day)	7.9	10.4	12.0	12.0		16.649	.000**
Alcohol (ADV)	1.0	2.1	1.0	2.0		.162	.687
Marijuana (ADJ)	0.2	1.0	0.1	0.5		.464	.496
Cocaine (% use)	8.4%	-	9.5%	-	.194		.659
Other Drug (% use)	5.4%	-	3.9%	-	.088		.767
Depression (CES-D)	38.1	9.9	37.5	9.3		.397	.529
Anxiety (STAI)	16.8	4.7	16.2	4.2		2.337	.127
Environmental Variables							
Family Income (avg. $/mo.)	1143	933	1240	871		1.400	.237
Home Environment (HSQ)	39.3	6.1	40.7	5.8		6.149	.013**
Man in House Alcohol/Drug Problems (% yes)	15.4%	-	15.9%	-	.002		.967
Physical Discipline (% yes)	33.5%	-	32.5%	-	.060		.806
Child Variables							
Family History (% yes)	80.5%	-	84.0%	-	1.030		.310
Depression/Anxiety (CBCL)	3.3	3.2	3.5	3.8		.570	.451
IQ (Stanford – Binet)	89.4	13.9	94.8	13.3		19.027	.000**
Ext. Behaviors (CBCL)	10.9	7.4	12.1	7.8		3.427	.065*
Aggression (CBCL)	8.8	6.2	9.8	6.5		3.340	.068*
Emotionality (EAS)	2.7	0.7	2.8	0.7		.664	.416
Activity (EAS)	3.8	0.8	3.9	0.8		1.137	.287
Sociability (EAS)	3.8	0.6	3.9	0.6		2.637	.105

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

* $p < .10$

** $p \leq .05$

Table 25. Age 10 Descriptive Statistics for Dichotomous Alcohol Outcomes

Variables	Never Use		Ever Use		Comparison Statistics		
	N = 353		N = 212				
	Mean	sd	Mean	sd	χ^2	F	p
Demographic Variables							
Child's Age	10.4	0.5	10.5	0.5		3.009	.083*
Gender (% male)	51.0%	-	43.9%	-	2.692		.101
Race (% Caucasian)	36.5%	-	61.3%	-	32.751		.000**
Maternal Variables							
Cigarettes (cig/day)	8.1	10.2	11.8	12.0		14.222	.000**
Alcohol (ADV)	1.2	3.6	1.0	1.9		.572	.450
Marijuana (ADJ)	0.1	0.3	0.1	0.3		.041	.839
Cocaine (% use)	6.4%	-	7.3%	-	.160		.689
Other Drug (% use)	1.5%	-	3.9%	-	2.977		.084*
Depression (CES-D)	37.8	9.5	38.4	9.6		.419	.518
Anxiety (STAI)	16.7	4.7	16.5	4.7		.306	.580
Environmental Variables							
Family Income (avg. $/mo.)	1423	1102	1588	1091		2.841	.092*
Home Environment (HOME)	12.5	2.7	12.9	2.7		3.261	.072*
Male in House Alcohol/Drug Problems (% yes)	11.5%	-	15.9%	-	1.123		.289
Physical Discipline (% yes)	19.9%	-	20.5%	-	.029		.864
Child Variables							
Depression (CDI)	45.5	8.3	47.1	9.0		4.326	.038**
Anxiety (RMCAS)	9.9	6.2	10.5	6.2		1.334	.249
IQ (Stanford – Binet)	90.1	11.2	94.0	11.6		14.960	.000**
Pubertal Status (PDS)	3.1	0.9	3.0	0.9		1.470	.226
Ext. Behaviors (CBCL)	10.2	7.2	11.9	7.7		6.442	.011**
Aggression (CBCL)	8.2	6.2	9.5	5.6		6.224	.013**
Status Offense (% yes)	18.7%	-	25.9%	-	3.879		.049**
Theft Offense (% yes)	14.7%	-	25.4%	-	9.428		.002**
Damage Offense (% yes)	14.4%	-	19.5%	-	2.433		.119
Emotionality (EAS)	2.6	0.7	2.6	0.6		.491	.484
Activity (EAS)	3.6	0.8	3.6	0.8		.823	.365
Sociability (EAS)	3.7	0.6	3.8	0.6		1.396	.238

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

* $p < .10$

** $p \leq .05$

Table 26. Prenatal and Age 6 Descriptive Statistics for Categorical Alcohol Outcomes

Variables	No Use		Non-Reg. [a]		Regular Use[b]		Comparison Statistics		
	N = 367		N = 97		N = 99				
	Mean	sd	Mean	sd	Mean	sd	χ^2	F	p
Demo. Variables									
Child's Age	6.4	0.4	6.4	0.3	6.5	0.6		2.002	.136
Gender (% male)	50.7%	-	53.6%	-	34.3%	-	9.650		.008**
Race (% Caucasian)	37.9%	-	59.8%	-	60.6%	-	25.689		.000**
Prenatal Variables									
Cigarettes (cig/day)	6.9	10.2	9.6	12.7	9.9	12.0		4.385	.013**
Alcohol (ADV)	0.6	1.5	0.6	1.1	0.5	0.8		.053	.948
Marijuana (ADJ)	0.4	1.0	0.4	0.9	0.5	1.2		.372	.689
Cocaine (% use)	2.5%	-	5.2%	-	4.0%	-	2.086		.352
Other Drug (% use)	8.7%	-	6.2%	-	13.1%	-	3.017		.221
Maternal Variables									
Cigarette (cig/day)	8.3	10.8	11.5	12.1	12.0	11.3		6.060	.002**
Alcohol (ADV)	1.0	2.1	0.9	1.8	1.1	2.3		.170	.844
Marijuana (ADJ)	0.2	1.0	0.1	0.2	0.2	0.7		.480	.619
Cocaine (% use)	8.4%	-	8.5%	-	11.0%	-	.635		.728
Other Drug (% use)	5.2%	-	7.5%	-	5.5%	-	.714		.700
Depression (CES-D)	38.2	9.9	36.1	8.2	38.4	10.2		1.911	.149
Anxiety (STAI)	16.9	4.8	15.6	3.6	16.4	4.5		3.094	.046**
Env. Variables									
Family Inc (avg. $ /mo)	1137	924	1422	960	1093	775		4.150	.016**
Home Env. (HSQ)	39.3	6.1	41.6	5.1	40.0	6.3		5.519	.004**
Male in House Alc/Drug Prob. (% y)	17.4%	-	6.6%	-	17.8%	-	4.458		.108
Phys. Disc. (% yes)	33.4%	-	37.2%	-	27.5%	-	2.044		.360
Child Variables									
Family History (% y)	81.1%	-	84.4%	-	81.3%	-	.545		.762
Dep./Anx. (CBCL)	3.3	3.1	3.4	3.8	3.6	4.0		.249	.780
IQ (Stanford – Binet)	89.6	14.0	96.1	13.0	93.2	12.9		9.294	.000**
Ext. Behav. (CBCL)	10.9	7.3	11.2	7.0	13.0	8.8		2.183	.061*
Aggression (CBCL)	8.8	6.2	9.0	5.6	10.6	7.4		2.871	.058*
Emotionality (EAS)	2.8	0.7	2.7	0.7	2.9	0.7		1.504	.223
Activity (EAS)	3.8	0.7	3.9	0.7	3.8	0.8		.755	.471
Sociability (EAS)	3.9	0.6	3.9	0.6	3.9	0.6		.665	.515

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

[a] Non-regular use < once/month

[b] Regular use $\geq$ once/month

* $p < .10$

** $p \leq .05$

Table 27. Age 10 Descriptive Statistics for Categorical Alcohol Outcomes

Variables	No Use		Non-Reg. [a]		Regular Use [b]		Comparison Statistics		
	N = 367		N = 97		N = 99				
	Mean	sd	Mean	sd	Mean	sd	χ^2	F	p
Demo. Variables									
Child's Age	10.4	0.5	10.5	0.5	10.6	0.6		1.823	.162
Gender (% male)	50.7%	-	53.6%	-	34.3%	-	9.650		.008**
Race (% Caucasian)	37.9%	-	59.8%	-	60.6%	-	25.689		.000**
Maternal Variables									
Cigarette (cig/day)	8.4	10.3	11.7	12.6	11.6	11.5		5.513	.004**
Alcohol (ADV)	1.2	3.6	1.1	2.3	0.9	1.7		.315	.730
Marijuana (ADJ)	0.1	0.3	0.1	0.2	0.1	0.4		.331	.718
Cocaine (% use)	6.2%	-	6.3%	-	9.4%	-	1.237		.539
Other Drug (% use)	1.8%	-	3.2%	-	4.2%	-	2.037		.361
Depression (CES-D)	37.9	9.4	37.2	9.4	39.4	10.0		1.341	.263
Anxiety (STAI)	16.7	4.7	16.4	4.8	16.6	4.7		.232	.793
Env. Variables									
Family Inc. (avg. $/mo.)	1416	1092	1732	1109	1489	1096		3.087	.046**
Home Env. (HOME)	12.5	2.7	13.2	2.3	12.7	2.8		2.572	.077*
Male in House Alc/Drug Prob. (% y)	11.7%	-	18.0%	-	13.8%	-	1.511		.470
Phys. Disc. (% yes)	19.5%	-	21.1%	-	20.8%	-	.167		.920
Child Variables									
Depression (CDI)	45.8	8.4	45.9	8.2	47.8	9.4		2.084	.125
Anxiety (RMCAS)	10.0	6.2	9.8	6.4	10.6	5.9		.429	.651
IQ (Stanford – Binet)	90.2	11.3	95.8	11.0	92.4	11.8		9.399	.000**
Pubertal Status (PDS)	3.1	0.9	3.5	1.0	2.9	0.8		2.084	.126
Ext. Behav. (CBCL)	10.3	7.3	11.7	7.3	11.7	7.9		2.137	.119
Aggression (CBCL)	8.2	5.9	9.5	5.5	9.4	6.2		2.500	.083*
Status Off. (% yes)	18.9%	-	21.1%	-	31.3%	-	6.796		.033**
Theft Off. (% yes)	14.5%	-	26.3%	-	27.1%	-	11.989		.002**
Damage Off. (% yes)	14.5%	-	23.2%	-	16.7%	-	4.102		.129
Emotionality (EAS)	2.6	0.7	2.6	0.6	2.6	0.7		.320	.726
Activity (EAS)	3.6	0.8	3.7	0.7	3.6	0.8		1.038	.355
Sociability (EAS)	3.7	0.6	3.8	0.5	3.8	0.6		.713	.491

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

[a] Non-regular use < once/month

[b] Regular use $\geq$ once/month

* $p < .10$

** $p \leq .05$

Table 28. Prenatal and Age 6 Descriptive Statistics for Dichotomous Marijuana Outcomes

Variables	Never Use		Ever Use		Comparison Statistics		
	N = 381		N = 185				
	Mean	sd	Mean	sd	χ^2	F	p
Demographic Variables							
Child's Age	6.4	0.4	6.5	0.5		.866	.352
Gender (% male)	47.5%	-	50.3%	-	.381		.537
Race (% Caucasian)	46.7%	-	43.8%	-	.432		.511
Prenatal Variables							
Cigarette (cig/day)	7.0	10.9	9.6	11.2		7.163	.008**
Alcohol (ADV)	0.5	1.0	0.7	1.7		3.668	.056*
Marijuana (ADJ)	0.3	0.7	0.6	1.4		8.433	.004**
Cocaine (% use)	3.4%	-	2.7%	-	.204		.652
Other Drug (% use)	8.1%	-	10.8%	-	1.086		.297
Maternal Variables							
Cigarettes (cig/day)	8.6	11.1	11.2	11.2		6.116	.014**
Alcohol (ADV)	0.9	1.7	1.3	2.7		2.783	.096*
Marijuana (ADJ)	0.1	0.9	0.2	0.7		.422	.516
Cocaine (% use)	7.2%	-	12.1%	-	3.470		.062*
Other Drug (% use)	4.4%	-	8.1%	-	2.897		.089*
Depression (CES-D)	37.8	9.7	38.1	9.5		.153	.696
Anxiety (STAI)	16.6	4.6	16.6	4.4		.009	.925
Environmental Variables							
Family Income (avg. $/mo.)	1255	968	1022	755		7.800	.005**
Home Environment (HSQ)	40.5	6.0	38.5	5.8		12.331	.000**
Man in House Alcohol/Drug Problems (% yes)	15.1%	-	16.0%	-	.033		.857
Physical Discipline (% yes)	31.3%	-	37.4%	-	1.938		.164
Child Variables							
Family History (% yes)	80%	-	85.5%	-	2.239		.135
Depression/Anxiety (CBCL)	3.3	3.3	3.5	3.6		.281	.596
IQ (Stanford – Binet)	91.4	14.3	91.4	12.9		.001	.975
Ext. Behaviors (CBCL)	10.7	7.2	12.7	8.1		9.013	.033**
Aggression (CBCL)	8.7	6.1	10.2	6.7		6.737	.010**
Emotionality (EAS)	2.7	0.7	2.8	0.8		1.670	.197
Activity (EAS)	3.8	0.8	3.8	0.8		.276	.600
Sociability (EAS)	3.9	0.6	3.9	0.6		.016	.899

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

* $p < .10$

** $p \leq .05$

Table 29. Age 10 Descriptive Statistics for Dichotomous Marijuana Outcomes

Variables	Never Use		Ever Use		Comparison Statistics		
	N = 381		N = 185				
	Mean	sd	Mean	sd	χ^2	F	p
Demographic Variables							
Child's Age	10.5	0.5	10.5	0.5		.091	.763
Gender (% male)	47.5%	-	50.3%	-	.381		.537
Race (% Caucasian)	46.7%	-	43.8%	-	.432		.511
Maternal Variables							
Cigarettes (cig/day)	8.9	11.2	10.9	10.7		3.843	.050**
Alcohol (ADV)	1.0	2.2	1.4	4.3		1.710	.192
Marijuana (ADJ)	0.1	0.3	0.1	0.4		4.325	.038**
Cocaine (% use)	4.8%	-	10.6%	-	6.377		.012**
Other Drug (% use)	1.7%	-	3.9%	-	2.453		.117
Depression (CES-D)	37.4	9.4	39.2	9.6		4.229	.040**
Anxiety (STAI)	16.6	4.7	16.7	4.7		.158	.691
Environmental Variables							
Family Income (avg. $/mo.)	1596	1164	1269	922		10.678	.001**
Home Environment (HOME)	12.9	2.6	12.1	2.8		11.464	.001**
Male in House Alcohol/Drug Problems (% yes)	11.2%	-	18.8%	-	2.985		.084*
Physical Discipline (% yes)	19.5%	-	21.2%	-	.224		.636
Child Variables							
Depression (CDI)	45.6	8.3	39.2	9.6		3.614	.058*
Anxiety (RMCAS)	9.9	6.0	16.7	4.7		.905	.342
IQ (Stanford – Binet)	91.5	11.5	91.7	11.7		.053	.818
Pubertal Status (PDS)	3.1	0.9	3.0	1.0		1.261	.262
Ext. Behaviors (CBCL)	10.1	7.1	12.2	8.0		9.091	.003**
Aggression (CBCL)	8.2	5.8	9.5	6.0		5.474	.020**
Status Offense (% yes)	17.0%	-	30.2%	-	12.355		.000**
Theft Offense (% yes)	15.5%	-	25.1%	-	7.193		.007**
Damage Offense (% yes)	14.7%	-	19.6%	-	2.059		.151
Emotionality (EAS)	2.6	0.7	2.6	0.7		1.518	.219
Activity (EAS)	3.6	0.8	3.7	0.8		1.494	.222
Sociability (EAS)	3.7	0.6	3.7	0.6		.129	.720

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

* $p < .10$

** $p \leq .05$

Table 30. Prenatal and Age 6 Descriptive Statistics for Categorical Marijuana Outcomes

Variables	No Use		Non-Reg. [a]		Regular Use[b]		Comparison Statistics		
	N = 393		N = 79		N = 90				
	Mean	sd	Mean	sd	Mean	sd	χ^2	F	p
Demo. Variables									
Child's Age	6.4	0.4	6.4	0.4	6.5	0.5		1.351	.260
Gender (% male)	47.6%	-	55.7%	-	43.3%	-	2.687		.261
Race (% Caucasian)	46.3%	-	49.4%	-	42.2%	-	.891		.641
Prenatal Variables									
Cigarettes (cig/day)	6.9	10.8	10.2	11.2	10.1	11.7		5.110	.006**
Alcohol (ADV)	0.5	1.1	0.5	0.7	0.9	2.3		3.547	.029**
Marijuana (ADJ)	0.3	0.8	0.6	1.4	0.6	1.4		4.135	.016**
Cocaine (% use)	3.6%	-	2.5%	-	2.2%	-	.558		.757
Other Drug (% use)	8.4%	-	12.7%	-	8.9%	-	1.452		.484
Maternal Variables									
Cigarette (cig/day)	8.5	11.0	11.7	10.8	11.9	11.9		4.919	.008**
Alcohol (ADV)	0.9	1.7	1.3	2.9	1.3	2.8		1.809	.165
Marijuana (ADJ)	0.1	0.9	0.1	0.7	0.2	0.7		.314	.731
Cocaine (% use)	7.5%	-	13.5%	-	10.7%	-	3.191		.203
Other Drug (% use)	4.6%	-	10.8%	-	6.0%	-	4.547		.103
Depression (CES-D)	38.0	9.8	35.8	8.4	39.4	9.6		2.729	.066*
Anxiety (STAI)	16.7	4.7	15.9	3.9	16.9	4.4		1.144	.319
Env. Variables									
Family Inc (avg. $ /mo)	1245	964	1120	751	947	758		3.889	.021**
Home Env. (HSQ)	40.4	6.1	39.6	5.2	38.0	5.9		5.618	.004**
Male in House Alc/Drug Prob. (% y)	15.6%	-	9.4%	-	17.1%	-	.980		.613
Phys. Disc. (% yes)	31.1%	-	31.1%	-	46.4%	-	7.459		.024**
Child Variables									
Family History (% yes)	80.7%	-	86.8%	-	82.7%	-	1.643		.440
Dep./Anx. (CBCL)	3.3	3.3	3.1	3.1	3.9	4.1		1.183	.307
IQ (Stanford – Binet)	91.3	14.2	95.7	12.7	88.8	12.6		5038	.007**
Ext. Behav. (CBCL)	10.6	7.1	12.2	8.0	13.7	8.5		6.480	.002**
Aggression (CBCL)	8.6	6.1	9.7	6.6	11.0	7.1		5.150	.006**
Emotionality (EAS)	2.7	0.7	2.8	0.7	2.9	0.8		1.477	.229
Activity (EAS)	3.8	0.8	3.8	0.7	3.9	0.8		.642	.527
Sociability (EAS)	3.9	0.6	3.8	0.7	4.0	0.5		1.682	.187

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

[a] Non-regular use < once/month

[b] Regular use $\geq$ once/month

* $p < .10$

** $p \leq .05$

Table 31. Age 10 Descriptive Statistics for Categorical Marijuana Outcomes

Variables	No Use		Non-Reg. [a]		Regular Use[b]		Comparison Statistics		
	N = 393		N = 79		N = 90				
	Mean	sd	Mean	sd	Mean	sd	χ^2	F	p
Demo. Variables									
Child's Age	10.5	0.5	10.5	0.6	10.5	0.5		.197	.821
Gender (% male)	47.6%	-	55.7%	-	43.3%	-	2.687		.261
Race (% Caucasian)	46.3%	-	49.4%	-	42.2%	-	.891		.641
Maternal Variables									
Cigarette (cig/day)	8.7	11.1	11.0	10.1	11.9	11.6		3.522	.030**
Alcohol (ADV)	1.0	2.2	1.5	5.8	1.3	2.8		1.287	.277
Marijuana (ADJ)	0.1	0.3	0.1	0.4	0.1	0.5		1.832	.161
Cocaine (% use)	4.6%	-	8.9%	-	14.3%	-	10.631		.005**
Other Drug (% use)	1.9%	-	5.1%	-	2.4%	-	2.693		.260
Depression (CES-D)	37.6	9.6	36.8	8.8	41.1	9.4		5.477	.004**
Anxiety (STAI)	16.6	4.7	16.0	4.3	17.3	5.0		1.652	.193
Env. Variables									
Family Inc. (avg. $/mo.)	1581	1151	1495	970	1066	885		7.666	.001**
Home Env. (HOME)	12.9	2.6	12.5	2.4	11.8	3.1		5.760	.003**
Male in House Alc/Drug Prob. (% y)	11.4%	-	15.4%	-	23.1%	-	3.878		.144
Phys. Disc. (% yes)	19.4%	-	19.0%	-	23.8%	-	.893		.640
Child Variables									
Depression (CDI)	45.7	8.2	46.5	8.8	48.0	9.9		2.502	.083*
Anxiety (RMCAS)	10.1	6.0	9.8	6.6	10.7	6.8		.457	.634
IQ (Stanford – Binet)	91.3	11.4	96.2	12.0	88.8	10.5		8.812	.000**
Pubertal Status (PDS)	3.1	0.9	3.0	1.0	3.0	0.9		.748	.474
Ext. Behav. (CBCL)	10.2	7.0	10.7	7.4	13.9	8.6		8.800	.000**
Aggression (CBCL)	8.2	5.7	8.5	5.7	10.8	6.4		6.433	.002**
Status Off. (% yes)	16.9%	-	25.3%	-	35.7%	-	15.385		.000**
Theft Off. (% yes)	15.9%	-	20.3%	-	31.0%	-	10.279		.006**
Damage Off. (% yes)	14.8%	-	15.2%	-	25.0%	-	5.326		.070*
Emotionality (EAS)	2.6	0.7	2.6	0.7	2.7	0.7		1.208	.299
Activity (EAS)	3.6	0.8	3.7	0.8	3.6	0.8		.843	.431
Sociability (EAS)	3.7	0.6	3.7	0.6	3.7	0.6		.128	.880

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

[a] Non-regular use < once/month

[b] Regular use $\geq$ once/month

* $p < .10$

** $p \leq .05$

Table 32. Prenatal and Age 6 Descriptive Statistics for Polysubstance Use Outcomes

Variables	No Use		Non-Reg. [a]		Regular Use [b]		Comparison Statistics		
	N = 220		N = 125		N = 220				
	Mean	sd	Mean	sd	Mean	sd	χ^2	F	p
Demo. Variables									
Child's Age	6.4	0.4	6.4	0.4	6.5	0.5		.789	.455
Gender (% male)	50.5%	-	48.8%	-	45.9%	-	.925		.630
Race (% Caucasian)	35.9%	-	52.0%	-	52.3%	-	14.317		.001**
Prenatal Variables									
Cigarettes (cig/day)	6.5	10.5	6.9	9.8	9.9	11.9		5.987	.003**
Alcohol (ADV)	0.6	1.2	0.4	0.7	0.7	1.6		2.165	.116
Marijuana (ADJ)	0.4	0.8	0.3	0.8	0.5	1.2		3.206	.041**
Cocaine (% use)	3.2%	-	1.6%	-	4.1%	-	1.604		.449
Other Drug (% use)	7.7%	-	10.4%	-	9.6%	-	.812		.666
Maternal Variables									
Cigarette (cig/day)	7.1	10.3	9.7	11.0	11.7	11.7		9.059	.000**
Alcohol (ADV)	1.0	1.7	0.8	1.4	1.2	2.7		1.939	.145
Marijuana (ADJ)	0.2	1.2	0.1	0.4	0.2	0.7		.190	.827
Cocaine (% use)	6.8%	-	9.0%	-	10.6%	-	1.861		.394
Other Drug (% use)	4.4%	-	6.6%	-	6.3%	-	.957		.620
Depression (CES-D)	37.4	10.1	38.5	9.3	38.0	9.5		.538	.584
Anxiety (STAI)	16.5	4.7	16.9	4.6	16.5	4.3		.254	.776
Env. Variables									
Family Inc (avg. $ /mo)	1172	983	1233	924	1156	829		.291	.747
Home Env. (HSQ)	39.8	5.9	40.3	6.3	39.6	6.0		.618	.539
Male in House Alc/Drug Prob. (% y)	18.9%	-	6.1%	-	17.6%	-	5.808		.005*
Phys. Disc. (% yes)	31.2%	-	34.4%	-	34.3%	-	.558		.757
Child Variables									
Family History (% y)	77.2%	-	86.1%	-	83.8%	-	4.892		.087*
Dep./Anx. (CBCL)	3.2	3.1	3.6	3.4	3.4	3.7		.345	.709
IQ (Stanford – Binet)	90.4	13.8	91.6	15.3	92.4	13.0		1.015	.363
Ext. Behav. (CBCL)	10.3	7.4	11.3	7.1	12.4	7.9		4.049	.018**
Aggression (CBCL)	8.3	6.4	9.1	5.9	10.0	6.5		3.299	.038**
Emotionality (EAS)	2.7	0.7	2.8	0.7	2.8	0.7		1.401	.247
Activity (EAS)	3.7	0.8	3.9	0.8	3.8	0.7		2.080	.126
Sociability (EAS)	3.8	0.7	4.0	0.6	3.9	0.6		5.722	.003**

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

[a] Non-regular use = use of single substance

[b] Regular use = use of two or more substances

* $p < .10$

** $p \leq .05$

Table 33. Age 10 Descriptive Statistics for Polysubstance Use Outcomes

Variables	No Use		Non-Reg. [a]		Regular Use [b]		Comparison Statistics		
	N = 220		N = 125		N = 220				
	Mean	sd	Mean	sd	Mean	sd	χ^2	F	p
Demo. Variables									
Child's Age	10.5	0.5	10.4	0.5	10.5	0.5		1.016	.363
Gender (% male)	50.5%	-	48.8%	-	45.9%	-	.925		.630
Race (% Caucasian)	35.9%	-	52.0%	-	52.3%	-	14.317		.001**
Maternal Variables									
Cigarette (cig/day)	7.3	10.0	9.2	10.8	11.9	11.7		9.001	.000**
Alcohol (ADV)	1.1	2.7	0.7	1.3	1.3	4.0		1.454	.235
Marijuana (ADJ)	0.1	0.3	0.1	0.3	0.1	0.4		.843	.431
Cocaine (% use)	5.0%	-	5.9%	-	9.0%	-	2.806		.246
Other Drug (% use)	1.5%	-	1.7%	-	3.8%	-	2.629		.269
Depression (CES-D)	37.0	9.3	39.0	9.5	38.5	9.7		2.036	.132
Anxiety (STAI)	16.7	4.5	16.8	5.1	16.5	4.7		.232	.793
Env. Variables									
Family Inc. (avg. $/mo.)	1421	990	1685	1384	1438	1008		2.503	.083*
Home Env. (HOME)	12.7	2.6	12.8	2.6	12.5	2.9		.737	.479
Male in House Alc/Drug Prob. (% y)	12.8%	-	8.7%	-	17.1%	-	2.661		.264
Phys. Disc. (% yes)	18.8%	-	19.5%	-	21.7%	-	.573		.751
Child Variables									
Depression (CDI)	45.3	8.3	46.1	8.6	47.0	8.8		2.159	.116
Anxiety (RMCAS)	9.4	5.9	10.8	6.6	10.4	6.2		2.097	.124
IQ (Stanford – Binet)	90.4	11.0	91.6	12.3	92.7	11.5		2.010	.135
Pubertal Status (PDS)	3.1	0.9	3.1	1.0	3.0	0.9		.636	.530
Ext. Behav. (CBCL)	9.8	7.2	10.3	7.0	12.1	7.8		5.055	.007**
Aggression (CBCL)	8.0	6.0	8.3	5.5	9.5	5.6		3.564	.029**
Status Off. (% yes)	14.9%	-	20.3%	-	28.3%	-	11.222		.004**
Theft Off. (% yes)	9.9%	-	22.9%	-	25.0%	-	17.107		.000**
Damage Off. (% yes)	12.9%	-	17.8%	-	18.9%	-	2.950		.229
Emotionality (EAS)	2.6	0.7	2.6	0.7	2.6	0.7		.322	.725
Activity (EAS)	3.5	0.8	3.6	0.8	3.7	0.8		1.274	.281
Sociability (EAS)	3.7	0.6	3.7	0.6	3.8	0.6		.843	.431

Significance based on ANOVAS for continuous and χ^2 tests for dichotomous variables

[a] Non-regular use = use of single substance

[b] Regular use = use of two or more substances

* $p < .10$

** $p \leq .05$

B. BIVARIATE ANALYSES

1. Temperament and Substance Use Outcomes

In order to address Hypothesis 1: Temperament, measured at ages 6 and 10, will significantly predict substance use at 14 years of age, logistic regressions for dichotomous outcomes, and ordinal polychotomous logistic regressions for categorical outcomes were run with only each temperament measurement and each substance use outcome in the model. Tables 34 and 35 show the results for these analyses.

Emotionality, activity, and sociability at age 6 were associated with dichotomous (Table 34) cigarette use outcomes. The more emotional, active, or sociable an individual was, the more likely they were to have ever smoked cigarettes. Sociability at age 6 was associated with categorical cigarette outcomes (Table 35), while emotionality and activity at age 6 did not meet the monotonic assumption of polychotomous logistic regression. Increased sociability at age 6 lead to increased risk of being in a higher cigarette use category. Activity and sociability at age 6 did not meet the monotonic assumptions of polychotomous logistic regression for categorical alcohol or marijuana outcomes. Emotionality at age 6 did not meet the monotonic assumptions of polychotomous logistic regression for categorical alcohol outcomes, and was not significant for categorical marijuana groups. All three temperament constructs at age 10 did not meet the monotonic assumption of polychotomous logistic regression for any categorical outcome for individual substances.

Hypothesis 2: Temperament, measured at ages 6 and 10, will distinguish between children who have not initiated substance use, those who have used a single substance, and those who have initiated use of multiple substances was addressed with ordinal polychotomous logistic

regression, in a manner similar to H1 analyses. Activity and sociability data from age 6, and emotionality and sociability data from age 10 did not meet the monotonic assumptions of polychotomous logistic regression. Emotionality at age 6 and activity at age 10 were not significant (Table 35).

Table 34. Temperament Measurements as Predictors of Dichotomous Substance Use Outcomes at age 14 [a]

Temperament	**Substance Used and Age of Temperament Measurement**							
	Cigarettes		Alcohol		Marijuana		Polysubstance	
	Age 6	Age 10	Age 6	Age 10	Age 6	Age 10	Age 6	Age 10
Emotionality	**.066**	.472	.415	.483	.197	.219	N/A	N/A
Activity	**.029**	.397	.286	.364	.599	.222	N/A	N/A
Sociability	**.003**	.155	.106	.238	.899	.719	N/A	N/A

[a] Values reported in this table are p-values from bivariate regressions
N/A = Not Assessed

Table 35. Temperament Measurements as Predictors of Categorical Substance Use Outcomes at age 14 [a]

Temperament	**Substance Used and Age of Temperament Measurement**							
	Cigarettes		Alcohol		Marijuana		Polysubstance	
	Age 6	Age 10	Age 6	Age 10	Age 6	Age 10	Age 6	Age 10
Emotionality	**	**	**	**	.127	**	.127	**
Activity	**	**	**	**	**	**	**	.113
Sociability	**.002**	**	**	**	**	**	**	**

[a] Values reported in this table are p-values from bivariate regressions
** did not meet monotonic assumption of polychotomous logistic regression

In order to address Hypotheses 3 – 5 for Specific Aim 2, identifying specific environmental/demographic, child, and maternal variables that predict and/or are associated with substance use at age 14 in the MHPCD cohort, bivariate logistic or ordinal logistic regressions were conducted for each substance use outcome. Within each substance, the results are reported by domain. This first step in addressing Specific Aim 2 was performed in order to reduce the number of variables to be entered into larger models for each substance use outcome. These results are summarized in Table 36.

Table 36. Variables for Larger Models Predicting Substance Use Outcomes by Age 14, Controlling for Race and Gender, Where Appropriate

Substance	**Cigarettes**						**Alcohol**						**Marijuana**						**Poly**		
Type of Outcome[a]	**D**			**C**			**D**			**C**			**D**			**C**			**C**		
Age[b]	**P**	**6**	**10**	**P**	**6**	**10**	**P**	**6**	**10**	**P**	**6**	**10**	**P**	**6**	**10**	**P**	**6**	**10**	**P**	**6**	**10**
Variable																					
Child IQ								X	X												
Child Dep.			X						X			X			X			X			X
Child Anx.			X						X												
Ext. Behav.		X	X		X	X		X	X		X	X		X	X		X	X		X	X
Pubertal Stat.																					
Child Aggr.		X	X		X	X		X	X		X			X	X		X	X		X	X
Status Off.			X			X			X			X			X			X			X
Theft Off.			X						X			X			X			X			X
Damage Off.									X									X			X
Fam. History			X			X															
Problems in Male in HH															X			X			
Mom Cig.		X	X		X	X		X	X		X		X	X	X		X	X	X	X	X
Mom Alc.													X								
Mom Mrj.													X		X						
Mom Coke														X	X			X			X
Mom Other Drug Use														X							
Mom Dep.		X	X		X	X									X						
Mom Anx.		X			X			X													
Phys. Disc.																					
Quality of the Home		X	X											X	X		X	X			
Avg. Family Income														X	X		X	X			
Race	X	X	X	X	X	X	X	X	X	X	X	X							X	X	X
Gender	X	X	X	X	X	X															

X = To be entered

[a] **D** = Dichotomous **C** = Categorical

[b] **P** = Prenatal **6** = age 6 **10** = age 10

2. Dichotomous Cigarette Outcome

Dichotomous cigarette use was defined as never versus ever having smoked a cigarette. Bivariate logistic regressions, as well as regression models including race and gender, were performed as the first step in data reduction. Race and gender were included since Caucasian race and female gender significantly predicted cigarette use outcomes. Variables with p-values < .10 were entered into the larger model.

The first variables to be examined came from the Child Domain (see Appendix B, Table 94). IQ at age 6 or 10 did not predict cigarette use by age 14. Child's depression at age 10 significantly predicted cigarette use with and without controlling for race and gender. Child's anxiety at age 10 was marginally significant by itself at predicting cigarette use. However, when controlling for race and gender, child's anxiety at age 10 became significant. The combined depression/anxiety measure used at age 6 did not predict cigarette use by age 14. Externalizing behavior by itself, as reported by the mother, was significant at ages 6 and 10, and remained significant when controlling for race and gender. Pubertal status did not predict cigarette use outcomes. Aggression at ages 6 and 10 significantly predicted cigarette use outcomes at 14. Status and theft offenses significantly predicted use of cigarettes by age 14, with and without controlling for race and gender, while damage offenses did not. Family history of an alcohol or drug problem in a child's biological relative significantly predicted cigarette use, even when controlling for race and gender, although alcohol or drug problems in the man in the household did not.

In the Maternal Domain (see Appendix B, Table 95), prenatal cigarette exposure significantly predicted cigarette use outcomes. However, this relationship was no longer

significant when race and gender were entered into the model. Other prenatal exposure variables were not significantly related to child cigarette use by age 14. Current maternal cigarette use at ages 6 and 10 significantly predicted cigarette use and remained significant when controlling for race and gender, while other current maternal substance use measures were not related to child's cigarette use by age 14. Maternal depression at ages 6 and 10 significantly predicted child cigarette use, whether race and gender were included in the model or not. Maternal anxiety at age 6 marginally predicted cigarette use with race and gender excluded and included, and at age 10 was not related. Physical discipline did not predict cigarette use by age 14.

In the Environmental/Demographic Domain (see Appendix B, Table 96), when controlling for race and gender, quality of the home environment at age 6 significantly predicted cigarette use and was marginally significant at age 10. Average family income was not related to cigarette use outcomes. Race and gender significantly predicted cigarette use bivariately and together.

3. Categorical Cigarette Outcome

Categorical cigarette use was defined as no use versus non-regular versus regular use. Bivariate ordinal logistic regressions, as well as regression models including race and gender, were performed as the first step in data reduction of categorical outcomes. Race and gender were included in these analyses because Caucasian race and female gender predicted categorical cigarette use outcomes. Variables with p-values < .10 were entered into the larger model.

The first variables to be examined came from the Child Domain (see Appendix B, Table 97). When controlling for race and gender, IQ at age 6 was marginally significant as a predictor of cigarette use. Child's depression at age 10 significantly predicted cigarette use groups with

and without controlling for race and gender. Child's anxiety at age 10 was marginally significant. However, when controlling for race and gender, child's anxiety at age 10 became significant. The combined depression/anxiety measure used at age 6 predicted cigarette use at age 14, but did not remain significant when controlling for race and gender. Externalizing behavior by itself, as reported by the mother, was significant at ages 6 and 10, and remained significant when controlling for race and gender. Pubertal status did not predict cigarette use outcomes. Aggression at ages 6 and 10 significantly predicted cigarette use outcomes at 14. Again, as with the dichotomous analyses, status and theft offenses predicted cigarette use outcomes, while damage offenses did not. Family history significantly predicted categorical cigarette use outcomes, although it became marginally significant when race and gender were included. Alcohol or drug problems in the man in the house were not associated with cigarette use at age 14.

In the Maternal Domain (see Appendix B, Table 98), prenatal cigarette exposure significantly predicted cigarette use outcomes. However, this relationship was no longer significant when race and gender were entered into the model. Other prenatal exposure variables were not significantly related to cigarette use at age 14. Maternal cigarette use at ages 6 and 10 significantly predicted cigarette use groups and remained significant when controlling for race and gender, while other maternal substance use measures at ages 6 and 10 were not related to child's cigarette use at age 14. Maternal depression at age 6 marginally predicted cigarette use, and became significant when race and gender were included. Maternal depression at age 10 significantly predicted child cigarette use, whether race and gender were included in the model or not. Maternal anxiety at age 6 marginally predicted cigarette use with race and gender

excluded and included, and at age 10 was not related. Physical discipline at age 10 was a marginal predictor of cigarette use when controlling for race and gender.

In the Environmental/Demographic Domain (see Appendix B, Table 99), when controlling for race and gender, quality of the home environment at age 6 significantly predicted cigarette use and was marginally significant at age 10. Average family income was not related to cigarette use outcomes. Race and gender significantly predicted cigarette use bivariately and together.

4. Dichotomous Alcohol Outcome

Dichotomous alcohol use was defined as never versus ever tried more then a sip or taste of alcohol. Bivariate ordinal logistic regressions, as well as regression models including race and gender, were performed as the first step in data reduction of categorical outcomes. Race and gender were included in these analyses because Caucasian race and female gender predicted alcohol use outcomes. Variables with p-values < .10 were entered into the larger model.

In the Child Domain (see Appendix B, Table 100), IQ at ages 6 and 10 significantly predicted more than a sip or taste of alcohol by age 14, and remained significant when controlling for race and gender. Child's depression at age 10 was significantly related to alcohol use with and without controlling for race and gender. Child's anxiety at age 10 was related to alcohol use when controlling for race and gender. The combined depression/anxiety measure used at age 6 did not predict alcohol use by age 14. Externalizing behavior, as reported by the mother, was significant at ages 6 and 10, and remained significant when controlling for race and gender. Pubertal status did not predict alcohol use by age 14. Aggression at age 6 marginally predicted alcohol use, and at age 10, significantly predicted alcohol use outcomes by 14. All

delinquency measures significantly predicted alcohol use by 14 when controlling for race and gender. Neither family history nor alcohol or drug problems in the man in the house were associated with alcohol use.

In the Maternal Domain (see Appendix B, Table 101), prenatal cigarette exposure significantly predicted alcohol use outcomes. However, this relationship was no longer significant when race and gender were entered into the model. Other prenatal exposure variables were not significantly related to alcohol use at age 14. Current maternal cigarette use at ages 6 significantly predicted alcohol use with and without controlling for race and gender. At age 10, current maternal cigarette use significantly predicted alcohol use, however, the relationship became marginally significant when controlling for race and gender. Other current maternal substance use measures were not related to child's alcohol use by age 14. Maternal depression at ages 6 and 10 was not related to alcohol use by 14. Maternal anxiety at age 6 marginally predicted alcohol use when controlling for race and gender, and was not related at age 10. Physical discipline did not predict alcohol use by age 14.

In the Environmental/Demographic Domain (see Appendix B, Table 102), quality of the home environment at age 6 and 10 predicted alcohol use, but was not significant once race and gender were entered into the model. Average family income was not related to alcohol use. Race significantly predicted alcohol use with and without controlling for gender, which was not related to alcohol use by age 14.

5. Categorical Alcohol Outcome

Categorical alcohol use was defined as no use versus non-regular versus regular use. Bivariate ordinal logistic regressions, as well as regression models including race and gender,

were performed as the first step in data reduction of categorical outcomes. Race and gender were included in these analyses because Caucasian race and female gender predicted categorical alcohol use outcomes. Variables with p-values < .10 were entered into the larger model.

In the Child Domain (see Appendix B, Table 103), IQ at age 6 significantly predicted alcohol use and when controlling for race and gender. IQ at age 10 significantly predicted alcohol use, but this relationship was no longer significant when race and gender were entered into the model. Child's depression at age 10 was marginally related to alcohol use with and without controlling for race and gender. Child's anxiety at age 10 was not related to alcohol use. The combined depression/anxiety measure used at age 6 did not predict alcohol use at age 14. Externalizing behavior, as reported by the mother, was significant at ages 6 and 10, and remained significant when controlling for race and gender. Pubertal status marginally predicted alcohol use outcomes and was significant when race and gender were entered into the model. Aggression at ages 6 and 10 significantly predicted alcohol use outcomes at 14. Again, all delinquency measures predicted alcohol use outcomes when controlling for race and gender. Neither family history nor alcohol or drug problems in the man in the house were associated with alcohol use.

In the Maternal Domain (see Appendix B, Table 104), prenatal cigarette exposure significantly predicted alcohol use outcomes. However, this relationship was no longer significant when race and gender were entered into the model. Other prenatal exposure variables were not significantly related to alcohol use at age 14. Current maternal cigarette use at ages 6 and 10 significantly predicted alcohol use groups. However, the relationship weakened when controlling for race and gender. Other current maternal substance use measures were not related to child's alcohol use at age 14. Maternal depression at ages 6 and 10 was not related to alcohol

use at 14. Maternal anxiety at age 6 marginally predicted alcohol use and significantly predicted with race and gender included, and was not related at age 10. Physical discipline did not predict alcohol use outcomes.

In the Environmental/Demographic Domain (see Appendix B, Table 105), quality of the home environment at age 6 and 10 predicted alcohol use, but was not significant once race and gender were entered into the model. Average family income was not related to alcohol use outcomes. Race and gender significantly predicted alcohol use bivariately and together.

6. Dichotomous Marijuana Outcome

Dichotomous marijuana use was defined as never versus ever tried marijuana. Since child's race and gender were not significantly related to marijuana use by age 14, they did not significantly change the results of the bivariate analyses. P-values were usually lower with the addition of race and gender, so only bivariate results, without race and gender in the model, are reported below, although results including race and gender are reported in Appendix B, Tables 106 - 108.

In the Child Domain (see Appendix B, Table 106), IQ did not predict child's marijuana use by age 14. Child's depression at age 10 marginally predicted marijuana use. Child's anxiety did not predict marijuana use. The combined depression/anxiety measure used at age 6 did not predict marijuana use by age 14. Externalizing behavior, as reported by the mother, was significant at ages 6 and 10. Pubertal status did not predict marijuana use by age 14. Aggression at ages 6 and 10 significantly predicted marijuana use outcomes at 14. Status and theft offenses predicted marijuana use by 14, while damage offenses did not. Family history did not predict marijuana use, but problems in the man in the house was marginally significant.

In the Maternal Domain (see Appendix B, Table 107), prenatal cigarette exposure significantly predicted marijuana use by age 14. Prenatal alcohol exposure was marginally related to marijuana use, while prenatal marijuana exposure was significantly related to marijuana use by age 14. Prenatal exposure to cocaine and other drugs were not significant predictors of marijuana use. Current maternal cigarette use at ages 6 and 10 significantly predicted marijuana use. Current maternal use of cocaine and other drugs were marginally significant at age 6. At age 10, current maternal cocaine use predicted marijuana use by age 14. Current maternal alcohol use was not related to marijuana use. Age 10 maternal marijuana use was marginally related to child marijuana use by age 14. Maternal depression at age 6 did not predict marijuana use, while maternal depression at age 10 significantly predicted child marijuana use by age 14. Maternal anxiety and physical discipline were not significant predictors of marijuana use by age 14.

In the Environmental/Demographic Domain (see Appendix B, Table 108), quality of the home environment at ages 6 and 10 predicted marijuana use. Average family income at ages 6 and 10 also predicted marijuana use by age 14.

7. Categorical Marijuana Outcome

Categorical marijuana use was defined as no use versus non-regular versus regular use. Since child's race and gender were not significantly related to marijuana use at age 14, they did not significantly change the results of the bivariate analyses. P-values were usually lower with the addition of race and gender, so only bivariate results are discussed below for marijuana.

In the Child Domain (see Appendix B, Table 109), IQ did not predict child's marijuana use at age 14. Child's depression at age 10 significantly predicted marijuana use groups. Child's

anxiety did not predict marijuana use. The combined depression/anxiety measure used at age 6 did not predict marijuana use at age 14. Externalizing behavior, as reported by the mother, was significant at ages 6 and 10. Pubertal status did not predict marijuana use outcomes. Aggression at ages 6 and 10 significantly predicted marijuana use outcomes at 14. Status and theft offenses were significant, and damage offenses were marginally significant, when controlling for race and gender. Family history did not predict marijuana use categories, although problems in the man in the house were marginally significant.

In the Maternal Domain (see Appendix B, Table 110), prenatal cigarette exposure significantly predicted marijuana use outcomes. Prenatal alcohol and marijuana exposure were significantly related to marijuana use at age 14, while prenatal exposure to cocaine and other drugs were not related. Current maternal cigarette use at ages 6 and 10 significantly predicted marijuana use groups. Maternal cocaine use at age 10 predicted child marijuana use at age 14. Current maternal alcohol use at age 6 and marijuana use at age 10 were marginally significant, while other current maternal substance use measures were not related to child's marijuana use at age 14. Maternal depression at age 6 did not predict marijuana use, while maternal depression at age 10 significantly predicted child marijuana use at age 14. Maternal anxiety did not predict marijuana use. Physical discipline at age 6 was a significant predictor of marijuana use at age 14.

In the Environmental/Demographic Domain (see Appendix B, Table 111), quality of the home environment at ages 6 and 10 predicted marijuana use. Average family income at ages 6 and 10 also predicted marijuana use.

8. Polysubstance Use

Polysubstance use was defined as no substances used versus one versus two or more substances used. In the Child Domain (see Appendix B, Table 112), IQ at age 6 did not predict use of multiple substances by age 14. IQ at age 10 was marginally related, but did not remain significant when race and gender were entered into the model. Child's depression at age 10 was significantly related to polysubstance use with and without controlling for race and gender. Child's anxiety at age 10 was not related to multiple substance use, but became marginally significant when controlling for race and gender. The combined depression/anxiety measure used at age 6 did not predict polysubstance use by age 14. Externalizing behavior, as reported by the mother, was significant at ages 6 and 10, and remained significant when controlling for race and gender. Pubertal status did not predict the use of multiple substances by age 14. Aggression significantly predicted polysubstance use by age 14, with and without including race and gender. All delinquency measures significantly predicted polysubstance use when race and gender were included in the model. Neither family history nor alcohol or drug problems in the man in the house were associated with polysubstance use.

In the Maternal Domain (see Appendix B, Table 113), prenatal cigarette exposure significantly predicted polysubstance use outcomes when race and gender were entered into the model. Other prenatal exposure variables were not significantly related to multiple substance use by age 14, with the exception of prenatal marijuana use, which was marginally significant when controlling for race and gender. Current maternal cigarette use at ages 6 and 10 significantly predicted substance use groups, and maternal cocaine use at age 10 was marginally significant. Other current maternal substance use measures were not related to child's use of multiple

substances by age 14. Maternal depression, anxiety, and physical discipline were not related to polysubstance use by age 14.

In the Environmental/Demographic Domain (see Appendix B, Table 114), quality of the home environment at age 6 and 10 did not predict polysubstance use by age 14, but was marginally significant once race and gender were entered into the model. Average family income was not related to substance use outcomes. Race was significantly related to the use of multiple substances by age 14, while gender was not related.

9. Summary

Variables that were entered into the multivariate model for each substance use outcome are listed in Table 36. During this first data reduction phase of the analyses, the variables were grouped by domain. Each covariate was entered into a regression model by itself, then with race and gender.

For dichotomous cigarette outcomes, child depression and anxiety at age 10, child externalizing behaviors and aggression at age 6 and 10, status and theft offenses at age 10, and a family history of drug or alcohol problems were considered for multivariate models. In the Maternal domain, maternal cigarette use and depression at child's ages 6 and 10 and maternal anxiety at age 6 were considered for multivariate models. In the environmental/demographic domain, quality of the home environment at ages 6 and 10, as well as race and gender, were considered for multivariate models. For categorical cigarette outcomes, race, gender, family history for alcohol/drug problems, maternal depression and cigarette use at child's ages 6 and 10, maternal anxiety at child's age 6, externalizing behaviors at ages 6 and 10, and aggression and status offenses at age 10 were considered for multivariate models. Quality of the home

environment at 6 and 10, physical discipline at age 10, child depression and anxiety at age 10, IQ and aggression at age 6, and theft offenses at age 10 did not meet the monotonic assumption of polychotomous logistic regression and were dropped from further analyses.

For dichotomous alcohol use outcomes, child IQ, externalizing behaviors, and aggression at ages 6 and 10 were entered into larger models predicting alcohol use at age 14. Child depression, anxiety, status, theft, and damage offenses at age 10 were also tested. In the maternal domain, cigarette use at ages 6 and 10, as well as maternal anxiety at age 6 were tested. In the environmental/demographic domain, race was also entered into the models. For categorical alcohol outcomes, race, maternal cigarette use at child's age 6, child depression at age 10, externalizing behaviors at ages 6 and 10, aggression at age 6, and status and theft offenses at age 10 were considered for multivariate models. Gender, family history of alcohol/drug problems, maternal anxiety at child's age 6, IQ at age 6, and pubertal status, aggression, and damage offenses at age 10 did not meet the monotonic assumption of polychotomous logistic regression and were dropped from further analyses.

For dichotomous marijuana outcomes, child externalizing behaviors and aggression at age 6 and 10 were entered into larger models. Child depression, status and theft offenses, as well as alcohol/drug problems in the man in the household, all measured at age 10, were also tested. In the maternal domain, substance use was tested, including prenatal cigarette, alcohol, and marijuana use, age 6 and 10 cigarette and cocaine use, age 10 marijuana use, and age 6 use of other drugs. Maternal depression at age 10 was also entered into larger models. In the environmental/demographic domain, age 6 and 10 quality of the home environment and family income were also tested. For categorical marijuana analyses, maternal cigarette use at child's ages 6 and 10, maternal cocaine use at child's age 10, quality of the home environment and

family income at ages 6 and 10, child depression, status, theft, and damage offenses at age 10, and externalizing behaviors and aggression at ages 6 and 10 were considered for multivariate models. Race, gender, family history of alcohol/drug problems, and prenatal cigarette, alcohol, and marijuana exposure, maternal depression and marijuana use at child's age 10, maternal alcohol use and use of physical discipline at child's age 6 did not meet the monotonic assumption of polychotomous logistic regression, and were dropped from further analyses.

For polysubstance use outcomes, race, gender, child externalizing behaviors and aggression at ages 6 and 10, child depression, status, theft, and damage offenses at age 10, prenatal and current maternal cigarette use, and maternal cocaine use at child's age 10 were considered for multivariate models. Family history of alcohol/drug problems, prenatal marijuana exposure, quality of the home environment at ages 6 and 10, and child anxiety at age 10 did not meet the monotonic assumption of polychotomous logistic regression, and were dropped from further analyses.

C. MODEL BUILDING

Based on the results of the data reduction analyses (bivariate regressions), larger models were built for each substance use outcome. These analyses were done hierarchically, for age 6, and separately for age 10 variables, with race, gender, family history and gestational exposures being entered first, followed by blocks of characteristics that were successively closer to substance use at age 14. The order and contents of the blocks were: 1) race, gender, prenatal substance exposure, and family history of drug and alcohol problems; 2) maternal substance use and psychological status at child's age 6 or 10; 3) age 6 and 10 home environment and physical

discipline; 4) age 6 and 10 child's psychological status, IQ, externalizing behaviors, and age 10 pubertal status; and 5) child's aggression (ages 6 and 10) and delinquency (age 10).

The associations between variables within each block and the substance use outcomes were tested (Tables 37-43). Table 37 shows that for age 6 models for dichotomous cigarette outcomes, family history of alcohol/drug problems, and maternal depression and anxiety were not significant in the block analysis, and were dropped from further analyses. At age 10, family history of alcohol/drug problems, and child depression and anxiety were no longer significant (Table 37). Table 38 shows that for categorical cigarette outcomes, family history of alcohol/drug problems, and maternal depression and anxiety were no longer significant, and were dropped from further analyses for age 6 variables. Quality of the home environment, child composite IQ score, and aggression did not meet the monotonic assumption of polychotomous logistic regression, and were dropped from these analyses. At age 10, family history of alcohol/drug problems and aggression were no longer significant (Table 38). Use of physical discipline, quality of the home environment, child depression, anxiety, and theft offenses at age 10 did not meet the monotonic assumption of polychotomous logistic regression, and were dropped from these analyses.

Table 37. Child, Maternal, and Environmental/Demographic Characteristics Associated with Dichotomous Cigarette Outcomes at Age 14 [a]

	Age 6		Age 10	
	β	p [b]	β	p [b]
Block 1. Prenatal and Family History				
Race	.657	.000*	.657	.000*
Gender	-.377	.034*	-.377	.034*
Family History Alcohol/Drug problems (%)	.256	.271	.256	.271
Block 2. Maternal Characteristics [c]				
Depression (CES-D)	.018	.204	.018	.053*
Anxiety (STAI)	.002	.948	N/A	N/A
Current No. cigarettes/day	.019	.031*	029	.000*
Block 3. Home Environment [c]				
Home environment (HOME)	-.036	.032*	-.067	.051*
Block 4. Child Characteristics [c]				
Depression (CDI)	N/A	N/A	.005	.742
Anxiety (RCMAS)	N/A	N/A	.026	.211
Externalizing Behaviors (CBCL)	.036	.003*	.029	.021*
Block 5. Child Problem Behavior [c]				
Aggression (CBCL)	.036	.011*	.026	.092*
Status Offenses (SRD)	N/A	N/A	.514	.027*
Theft Offenses (SRD)	N/A	N/A	.557	.021*

* $p < .10$

a. Logistic regression

b. Controlling for other variables within the block

c. Controlling for significant variables from block 1

Table 38. Child, Maternal, and Environmental/Demographic Characteristics Associated with Categorical Cigarette Outcomes at Age 14 [a]

	Age 6		Age 10	
	β	p [b]	β	p [b]
Block 1. Prenatal and Family History				
Race	.838	.000*	.838	.000*
Gender	-.461	.008*	-.461	.008*
Family History Alcohol/Drug problems (%)	.168	.456	.168	.456
Block 2. Maternal Characteristics [c]				
Depression (CES-D)	.021	.132	.021	.020*
Anxiety (STAI)	-.003	.916	N/A	N/A
Current No. cigarettes/day	.020	.010*	.022	.007*
Block 3. Home Environment [c]				
Home environment (HOME)	**	**	**	**
Physical Discipline	N/A	N/A	**	**
Block 4. Child Characteristics [c]				
Depression (CDI)	N/A	N/A	**	**
Anxiety (RCMAS)	N/A	N/A	**	**
Composite IQ (Stanford-Binet)	**	**	N/A	N/A
Externalizing Behaviors (CBCL)	.031	.006*	.027	.025*
Block 5. Child Problem Behavior [c]				
Aggression (CBCL)	**	**	.024	.113
Status Offenses (SRD)	N/A	N/A	.703	.001*
Theft Offenses (SRD)	N/A	N/A	**	**

* $p < .10$

** excluded for violating monotonic assumption of polychotomous logistic regression

a. Polychotomous logistic regression

b. Controlling for other variables within the block

c. Controlling for significant variables from block 1

For dichotomous alcohol outcomes, Table 39 shows that family history of alcohol/drug problems could be dropped from further analyses of age 6 variables, while family history of alcohol/drug problems, and child depression, anxiety, aggression, and damage offenses were no longer significant at age 10. For categorical alcohol outcomes, gender, family history of

alcohol/drug problems, maternal anxiety, and child's IQ did not meet the monotonic assumption of polychotomous logistic regression and were dropped from further analyses for age 6 variables (Table 40). At age 10, child depression was no longer significant, while gender, family history of alcohol/drug problems, pubertal status, aggression, and damage offenses did not meet the monotonic assumption of polychotomous logistic regression and were dropped from further analyses (Table 40).

Table 39. Child, Maternal, and Environmental/Demographic Characteristics Associated with Dichotomous Alcohol Outcomes at Age 14 [a]

	Age 6		Age 10	
	β	p [b]	β	p [b]
Block 1. Prenatal and Family History				
Race	.950	.000*	.950	.000*
Family History Alcohol/Drug prob. (%)	.195	.424	.195	.424
Block 2. Maternal Characteristics [c]				
Anxiety (STAI)	-.043	.043*	N/A	N/A
Current No. cigarettes/day	.023	.008*	.017	.053*
Block 4. Child Characteristics [c]				
Depression (CDI)	N/A	N/A	.022	.155
Anxiety (RCMAS)	N/A	N/A	.014	.520
Externalizing Behaviors (CBCL)	.027	.027*	.029	.028*
Composite IQ (Stanford-Binet)	.022	.002*	.025	.007*
Block 5. Child Problem Behavior [c]				
Aggression (CBCL)	.026	.071*	.025	.114
Status Offenses (SRD)	N/A	N/A	.468	.054*
Theft Offenses (SRD)	N/A	N/A	.575	.023*
Damage Offenses (SRD)	N/A	N/A	.208	.449

* $p < .10$

a. Logistic regression

b. Controlling for other variables within the block

c. Controlling for significant variables from block 1

Table 40. Child, Maternal, and Environmental/Demographic Characteristics Associated with Categorical Alcohol Outcomes at Age 14 [a]

	Age 6		Age 10	
	β	p [b]	β	p [b]
Block 1. Prenatal and Family History				
Race	.850	.000*	.850	.000*
Gender	**	**	**	**
Family History Alcohol/Drug problems (%)	**	**	**	**
Block 2. Maternal Characteristics [c]				
Anxiety (STAI)	**	**	N/A	N/A
Current No. cigarettes/day	.016	.050*	N/A	N/A
Block 4. Child Characteristics [c]				
Depression (CDI)	N/A	N/A	.016	.144
Anxiety (RCMAS)	N/A	N/A	N/A	N/A
Externalizing Behaviors (CBCL)	.031	.011*	.023	.070*
Composite IQ (Stanford-Binet)	**	**	N/A	N/A
Pubertal Status (PDS) [d]	N/A	N/A	**	**
Block 5. Child Problem Behavior [c]				
Aggression (CBCL)	.031	.027*	**	**
Status Offenses (SRD)	N/A	N/A	.645	.006*
Theft Offenses (SRD)	N/A	N/A	.610	.010*
Damage Offenses (SRD)	N/A	N/A	**	**

* $p < .10$

** excluded for violating monotonic assumption of polychotomous logistic regression

a. Ordinal polychotomous logistic regression

b. Controlling for other variables within the block

c. Controlling for significant variables from block 1

d. Coded on a 5-point scale from developed very early relative to peers (1) to developed much later than peers (5).

For dichotomous marijuana outcomes, Table 41 shows that for age 6 analyses, family history of alcohol/drug problems, prenatal alcohol exposure, and maternal cocaine and other drug use were no longer significant and were dropped from further analyses. At age 10, family history of alcohol/drug problems, prenatal alcohol exposure, maternal depression and marijuana

use, child depression, and theft offenses were no longer significant predictors of ever use of marijuana by age 14 (Table 41). For categorical marijuana outcomes, family history of alcohol/drug problems, prenatal substance exposure, maternal alcohol use, and the use of physical discipline did not meet the monotonic assumption of polychotomous logistic regression and were dropped from further age 6 variable analyses (Table 42). At age 10, child depression and damage offenses were no longer significant, while family history of alcohol/drug problems, prenatal substance exposure, and maternal depression and marijuana use did not meet the monotonic assumption of polychotomous logistic regression and were dropped from further analyses (Table 42).

Table 41. Child, Maternal, and Environmental/Demographic Characteristics Associated with Dichotomous Marijuana Outcomes at Age 14 [a]

	Age 6		Age 10	
	β	p [b]	β	p [b]
Block 1. Prenatal and Family History				
Race	-.269	.196	-.269	.196
Gender	.101	.592	.101	.592
Family History Alcohol/Drug problems (%)	.319	.217	.319	.217
Prenatal Cigarette Use	.022	.018*	.022	.018*
Prenatal Alcohol Use	.109	.151	.109	.151
Prenatal Marijuana Use	.169	.076*	.169	.076*
Block 2. Maternal Characteristics				
Depression (CES-D)	N/A	N/A	.015	.119
Current No. cigarettes/day	.018	.031*	.014	.098*
Current No. joints/day (ADJ)	N/A	N/A	.443	.113
Current Cocaine Use (% use)	.438	.168	.654	.068*
Current Other Drug (% use)	.450	.250	N/A	N/A
Block 3. Home Environment [c]				
Home environment (HOME)	-.044	.009*	-.079	.032*
Average Income per month	.000	.094*	.000	.044*
Block 4. Child Characteristics [c]				
Depression (CDI)	N/A	N/A	.010	.376
Externalizing Behaviors (CBCL)	.034	.006*	.031	.012*
Block 5. Child Problem Behavior [c]				
Aggression (CBCL)	.035	.016*	.029	.074*
Status Offenses (SRD)	N/A	N/A	.605	.008*
Theft Offenses (SRD)	N/A	N/A	.358	.139

* $p < .10$

a. Ordinal polychotomous logistic regression

b. Controlling for other variables within the block

c. Controlling for significant variables from block 1

Table 42. Child, Maternal, and Environmental/Demographic Characteristics Associated with Categorical Marijuana Outcomes at Age 14 [a]

	Age 6		Age 10	
	β	p [b]	β	p [b]
Block 1. Prenatal and Family History				
Race	**	**	**	**
Gender	**	**	**	**
Family History Alcohol/Drug problems (%)	**	**	**	**
Prenatal Cigarette Use	**	**	**	**
Prenatal Alcohol Use	**	**	**	**
Prenatal Marijuana Use	**	**	**	**
Block 2. Maternal Characteristics				
Depression (CES-D)	N/A	N/A	**	**
Current No. cigarettes/day	.025	.002*	.020	.014*
Current No. drinks/day (ADV)	**	**	N/A	N/A
Current No. joints/day (ADJ)	N/A	N/A	**	**
Current Cocaine Use (% use)	N/A	N/A	.849	.012*
Block 3. Home Environment				
Home environment (HOME)	-.034	.042*	-.082	.024*
Average Income per month	.000	.082*	.000	.015*
Physical Discipline (% yes)	**	**	N/A	N/A
Block 4. Child Characteristics				
Depression (CDI)	N/A	N/A	.017	.125
Externalizing Behaviors (CBCL)	.042	.000*	.039	.002*
Block 5. Child Problem Behavior				
Aggression (CBCL)	.044	.002*	.040	.011*
Status Offenses (SRD)	N/A	N/A	.656	.004*
Theft Offenses (SRD)	N/A	N/A	.445	.066*
Damage Offenses (SRD)	N/A	N/A	.026	.921

* $p < .10$

** excluded for violating monotonic assumption of polychotomous logistic regression

a. Ordinal polychotomous logistic regression

b. Controlling for other variables within the block

For polysubstance use outcomes, family history of alcohol/drug problems, prenatal marijuana exposure, and quality of the home environment did not meet the monotonic assumption of polychotomous logistic regression and were dropped from further age 6 variable analyses (Table 43). At age 10, maternal cocaine use and child depression were no longer significant predictors of multiple substance use, while family history of alcohol/drug problems, prenatal marijuana exposure, quality of the home environment, and child anxiety did not meet the monotonic assumption of polychotomous logistic regression and were dropped from these analyses (Table 43).

Table 43. Child, Maternal, and Environmental/Demographic Characteristics Associated with Polysubstance Use at Age 14 [a]

	Age 6		Age 10	
	β	p [b]	β	p [b]
Block 1. Prenatal and Family History				
Race	.421	.017*	.421	.017*
Gender	-.136	.405	-.136	.405
Family History	**	**	**	**
Alcohol/Drug problems (%)				
Prenatal Cigarette Use	.015	.059*	.015	.059*
Prenatal Marijuana Use	**	**	**	**
Block 2. Maternal Characteristics [c]				
Current No. cigarettes/day	.028	.000*	.026	.001*
Current Cocaine (% use)	N/A	N/A	.504	.127
Block 3. Home Environment [d]				
Home environment	**	**	**	**
Block 4. Child Characteristics [d]				
Depression (CDI)	N/A	N/A	.010	.482
Anxiety (RCMAS)	N/A	N/A	**	**
Externalizing Behaviors (CBCL)	.031	.004*	.029	.011*
Block 5. Child Problem Behavior [d]				
Aggression (CBCL)	.033	.010*.	.026	.070*
Status Offenses (SRD)	N/A	N/A	.625	.004*
Theft Offenses (SRD)	N/A	N/A	.664	.004*
Damage Offenses (SRD)	N/A	N/A	.008	.975

* $p < .10$

** excluded for violating monotonic assumption of polychotomous logistic regression

a. Ordinal polychotomous logistic regression

b. Controlling for other variables within the block

c. Controlling for race

d. Controlling for significant variables from block 1

Both externalizing behaviors and aggression were significant predictors of substance use outcomes in most models. These variables have been analyzed separately until this point in the analyses. However, since the externalizing behaviors score from the CBCL is a composite of various subscales, including the aggression subscale and a delinquency subscale, which is not

used in these analyses, both externalizing behaviors scores and aggression scores cannot be entered into the same model. Since delinquency at age 10 was measured with the SRD, and because it would not be possible to determine which aspect of the externalizing behaviors scores, delinquency or aggression, was driving the significant results, the externalizing behaviors scale was dropped from the remainder of the analyses, while the aggression subscale was included.

D. REDUCED MODELS

The variables in Blocks 1 to 5 that had p-values < .10 in the hierarchical analyses were entered, by block, into an age 6 or age 10 logistic, or ordinal polychotomous logistic, regression model to find the most parsimonious set of predictors. Also, because externalizing behaviors were dropped from the analyses, any other variables from Block 4 that were not significant when controlling for externalizing behaviors, such as child depression and anxiety, were included in the larger models. Once the reduced models were established, the variables that had been removed were added back in, one at a time, to see if they were significant in the smaller models.

In the age 6 model for dichotomous cigarette outcomes, gender and race were entered first, followed by mother's current cigarette use, quality of the home environment, and aggression (Table 37). Aggression was no longer significant, leaving a model that included female gender, Caucasian race, maternal cigarette use, and poorer quality of the home environment as predictors of cigarette use by age 14 (Table 44).

Table 44. Age 6 Reduced Model for Dichotomous Cigarette Outcome

	β	S.E.	Wald	Sig.	OR	95% C.I. for OR	
						Lower	Upper
Gender	-.389	.181	4.620	.032	.678	.476	.966
Race	.682	.213	10.234	.001	1.978	1.302	3.004
Maternal Cigarette Use	.020	.009	5.085	.024	1.020	1.003	1.037
Home Environment	-.033	.017	3.868	.049	.967	.936	1.000
Constant	.930	.648	2.058	.151	2.535		

In the age 10 model for dichotomous cigarette outcomes, gender and race were entered first, followed by maternal cigarette use, the quality of the home environment, child depression, anxiety, aggression, and status and theft offenses (Table 37). The quality of the home environment, child depression, anxiety, and aggression were no longer significant when controlling for maternal cigarette use, leaving a model that included female gender, Caucasian race, maternal cigarette use, and presence of status and theft offenses as predictors of cigarette use by age 14 (Table 45).

Table 45. Age 10 Reduced Model for Dichotomous Cigarette Outcome

	β	S.E.	Wald	Sig.	OR	95% C.I. for OR	
						Lower	Upper
Gender	-.474	.183	6.688	.010	.623	.435	.892
Race	.599	.194	9.564	.002	1.821	1.246	2.663
Maternal Cigarette Use	.022	.009	6.531	.011	1.023	1.005	1.040
Status Offenses	.506	.233	4.720	.030	1.659	1.051	2.618
Theft Offenses	.603	.242	6.222	.013	1.827	1.138	2.934
Constant	-.567	.171	10.973	.001	.567		

In the age 6 model for categorical cigarette outcomes, gender and race were entered first, followed by maternal depression and cigarette use (Table 38). All these variables remained significant, so female gender, Caucasian race, and increased maternal depression and cigarette use predicted the categorical cigarette outcome (Table 46).

Table 46. Age 6 Reduced Model for Categorical Cigarette Outcome

	β	S.E.	Wald	Sig.	Cumulative Odds Ratio
Gender	-.467	.174	7.194	.007	.627
Race	.674	.182	13.760	.000	1.962
Maternal Depression	.020	.009	4.709	.030	1.020
Maternal Cigarette Use	.020	.008	6.582	.010	1.020

In the age 10 model for categorical cigarette outcomes, gender and race were entered first, followed by maternal depression and cigarette use, and status offenses (Table 38). All these variables remained significant, so female gender, Caucasian race, increased maternal depression and cigarette use, as well as status offenses predicted the categorical cigarette outcome (Table 47).

Table 47. Age 10 Reduced Model for Categorical Cigarette Outcome

	β	S.E.	Wald	Sig.	Cumulative Odds Ratio
Gender	-.572	.179	10.218	.001	.564
Race	.848	.190	19.967	.000	2.335
Maternal Depression	.020	.009	4.860	.027	1.020
Maternal Cigarette Use	.021	.008	6.354	.012	1.021
Status Offenses	.782	.215	13.156	.000	2.186

In the age 6 model for dichotomous alcohol outcomes, race was entered first, followed by maternal anxiety and cigarette use, child's IQ and aggression (Table 39). Caucasian race, decreased maternal anxiety, maternal cigarette use, and increased child IQ and aggression remained significant predictors of having tried more than a sip or taste of alcohol by age 14 (Table 48).

Table 48. Age 6 Reduced Model for Dichotomous Alcohol Outcome

	β	S.E.	Wald	Sig.	OR	95% C.I. or OR	
						Lower	Upper
Race	.694	.205	11.511	.001	2.002	1.341	2.990
Maternal Anxiety	-.044	.022	3.814	.051	.957	.916	1.000
Maternal Cigarette Use	.021	.009	5.842	.016	1.021	1.004	1.039
Composite IQ	.020	.007	7.249	.007	1.020	1.005	1.035
Aggression	.033	.015	4.615	.032	1.034	1.003	1.066
Constant	-2.461	.803	9.401	.002	.085		

In the age 10 model for dichotomous alcohol outcomes, race was entered first, followed by maternal cigarette use, child depression, anxiety, IQ, and status and theft offenses (Table 39). Maternal cigarette use and child depression and anxiety were not significant at a $p \leq .05$ level when controlling for race, leaving a model that included Caucasian race, increased IQ, status and theft offenses as predictors of ever trying more than a sip or taste of alcohol by age 14 (Table 49).

Table 49. Age 10 Reduced Model for Dichotomous Alcohol Outcome

	β	S.E.	Wald	Sig.	OR	95% C.I. for OR	
						Lower	Upper
Race	1.002	.205	23.961	.000	2.723	1.823	4.067
Composite IQ Score	.020	.009	5.271	.022	1.020	1.003	1.038
Status Offenses	.535	.238	5.054	.025	1.708	1.071	2.723
Theft Offenses	.716	.245	8.549	.003	2.046	1.266	3.307
Constant	-3.076	.806	14.556	.000	.046		

In the age 6 model for categorical alcohol outcomes, race was entered first, followed by maternal cigarette use, and child aggression (Table 40). Maternal cigarette use was not significant when controlling for child aggression, which left Caucasian race and increased aggression as predictors of the categorical outcome (Table 50).

Table 50. Age 6 Reduced Model for Categorical Alcohol Outcome

	β	S.E.	Wald	Sig.	Cumulative Odds Ratio
Race	.832	.182	20.834	.000	2.298
Aggression	.030	.014	4.584	.032	1.030

In the age 10 model for categorical alcohol outcomes, race was entered first, followed by status and theft offenses (Table 40). Caucasian race and presence of status and theft offenses predicted the categorical alcohol outcome (Table 51).

Table 51. Age 10 Reduced Model for Categorical Alcohol Outcome

	β	S.E.	Wald	Sig.	Cumulative Odds Ratio
Race	1.049	.188	30.977	.000	2.855
Status Offenses	.580	.225	6.641	.010	1.786
Theft Offenses	.641	.227	7.937	.005	1.898

In the age 6 model for dichotomous marijuana outcomes, prenatal cigarette and marijuana exposure were entered first, followed by quality of the home environment, average family income, and child aggression (Table 41). Since maternal cigarette use at age 10 was not a significant predictor of marijuana use ($p = .098$), and because prenatal exposure had a greater effect size and lower p-value than maternal cigarette use at age 6, prenatal cigarette exposure was kept in the age 6 model. This left prenatal cigarette and marijuana exposure, poorer quality of the home environment, and increased child aggression as predictors of marijuana initiation by age 14 (Table 52).

Table 52. Age 6 Reduced Model for Dichotomous Marijuana Outcome

	β	S.E.	Wald	Sig.	OR	95% C.I. for OR	
						Lower	Upper
Prenatal Cigarette Use	.020	.009	5.509	.019	1.020	1.003	1.037
Prenatal Marijuana Use	.197	.101	3.816	.051	1.218	.999	1.485
Home Environment	-.051	.016	10.000	.002	.950	.920	.981
Aggression	.030	.015	4.089	.043	1.031	1.001	1.061
Constant	.787	.679	1.345	.246	2.197		

In the age 10 model for dichotomous marijuana outcomes, prenatal cigarette and marijuana exposure were entered first, followed by maternal cocaine use, quality of the home environment, average family income, child depression, aggression, and status offenses (Table

41). Again, since maternal cigarette use at age 10 was not a significant predictor of marijuana use (p = .098), prenatal cigarette exposure was kept in the age 6 model. Maternal cocaine use, family income, and child depression and aggression were not significant when controlling for prenatal substance use. This left prenatal cigarette and marijuana exposure, poorer quality of the home environment, and presence of status offenses as predictors of marijuana initiation by age 14 (Table 53).

Table 53. Age 10 Reduced Model for Dichotomous Marijuana Outcome

	β	S.E.	Wald	Sig.	OR	95% C.I. for OR	
						Lower	Upper
Prenatal Cigarette Use	.020	.008	5.577	.018	1.020	1.003	1.037
Prenatal Marijuana Use	.199	.096	4.269	.039	1.220	1.010	1.474
Home Environment	-.095	.035	7.215	.007	.909	.848	.975
Status Offenses	.687	.221	9.662	.002	1.987	1.289	3.063
Constant	.095	.468	.041	.839	1.100		

In the age 6 model for categorical marijuana outcomes, maternal cigarette use was entered first, followed by quality of the home environment, average family income, and child aggression (Table 42). Family income was not significant, leaving maternal cigarette use, poorer quality of the home environment, and increased aggression as predictors of the categorical marijuana outcome (Table 54).

Table 54. Age 6 Reduced Model for Categorical Marijuana Outcome

	β	S.E.	Wald	Sig.	Cumulative Odds Ratio
Maternal Cigarette Use	.024	.008	8.735	.003	1.024
Home Environment	-.052	.016	10.249	.001	.949
Aggression	.036	.015	5.992	.014	1.037

In the age 10 model for categorical marijuana outcomes, maternal cigarette and cocaine use were entered first, followed by quality of the home environment, average family income, child depression, aggression, and status and theft offenses (Table 42). Average family income,

child depression, and aggression were not significant, leaving maternal cigarette and cocaine use, poorer quality of the home environment, and presence of status and theft offenses as predictors of the categorical marijuana outcome(Table 55).

Table 55. Age 10 Reduced Model for Categorical Marijuana Outcome

	β	S.E.	Wald	Sig.	Cumulative Odds Ratio
Maternal Cigarette Use	.024	.008	8.087	.004	1.024
Maternal Cocaine Use	.837	.337	6.151	.013	2.309
Home Environment	-.089	.035	6.422	.011	.915
Status Offenses	.612	.226	7.309	.007	1.844
Theft Offenses	.563	.237	5.650	.017	1.756

In the age 6 model for polysubstance use outcomes, race was entered first, followed by maternal cigarette use and child aggression (Table 43). Current maternal cigarette use was entered into this model since it has a greater effect size and lower p-value than prenatal cigarette exposure. Race was not significant once maternal cigarette use was entered into the model, leaving maternal cigarette use and increased child aggression as predictors of the polysubstance use outcome (Table 56).

Table 56. Age 6 Reduced Model for Polysubstance Outcome

	β	S.E.	Wald	Sig.	Cumulative Odds Ratio
Maternal Cigarette Use	.029	.008	14.451	.000	1.029
Aggression	.028	.013	4.655	.031	1.028

In the age 10 model for polysubstance use outcomes, maternal cigarette use was entered first, followed by child depression, aggression, and status and theft offenses (Table 43). Current maternal cigarette use was entered into this model since it has a greater effect size and lower p-value than prenatal cigarette exposure. Child depression and aggression were not significant at a

$p \leq .05$ level. Maternal cigarette use and presence of status and theft offenses predicted the polysubstance use outcome (Table 57).

Table 57. Age 10 Reduced Model for Polysubstance Outcome

	β	S.E.	Wald	Sig.	Cumulative Odds Ratio
Maternal Cigarette Use	.033	.008	18.622	.000	1.034
Status Offenses	.516	.209	6.073	.014	1.675
Theft Offenses	.714	.223	10.284	.001	2.042

These reduced models were then used to test Hypothesis 6: The direct effect of temperament will remain when other characteristics of the child (gender, IQ), the mother (maternal substance use, maternal psychopathology, parenting practices), and the environment (demographic characteristics) are entered into the model.

E. EFFECTS OF TEMPERAMENT ON SUBSTANCE USE, CONTROLLING FOR COVARIATES

It was previously shown that Emotionality, Activity, and Sociability at age 6 were only related to cigarette use outcomes (Tables 34 & 35). While alcohol and marijuana models were tested for age 6, as well as for age 10 temperament measures and each substance use outcome, there were no significant results for temperament in those models, and those results are not reported.

Tables 58 – 60 show the results when temperament was entered into the reduced model for age 6 predictors of dichotomous cigarette use outcomes at age 14. Increased activity (Table 58) and increased sociability (Table 59) remained significant predictors of ever use of cigarettes when controlling for gender, race, maternal cigarette use, and quality of the home environment, while emotionality (Table 60) was not significant when controlling for these variables. Tables

61 shows the results when temperament was entered into the reduced model for age 6 predictors of categorical cigarette use outcomes at age 14. Increased sociability (Table 61) remained a significant predictor of the categorical cigarette outcome when controlling for gender, race, and maternal depression and cigarette use. However, a multiple comparisons test showed that there was no significant difference in mean sociability scores between non-regular and regular cigarette users. Tukey's Honestly Significant Different (HSD) test showed the difference was between those who smoked and those who did not (non-users vs. non-regular users, p = .019, non-users vs. regular users, p= .034, non-regular vs. regular users, p = .860).

Table 58. Dichotomous Cigarette Use Outcomes and Age 6 Activity

	β	S.E.	Wald	Sig.	OR	95% C.I. for OR	
						Lower	Upper
Gender	-.452	.184	6.011	.014	.636	.444	.913
Race	.649	.215	9.103	.003	1.914	1.255	2.917
Maternal Cigarette Use	.019	.009	4.634	.031	1.019	1.002	1.037
Home Environment	-.035	.017	4.134	.042	.966	.934	.999
Activity	.254	.122	4.347	.037	1.289	1.015	1.637
Constant	.077	.757	.010	.919	1.080		

Table 59. Dichotomous Cigarette Use Outcomes and Age 6 Sociability

	β	S.E.	Wald	Sig.	OR	95% C.I. for OR	
						Lower	Upper
Gender	-.395	.182	4.715	.030	.674	.471	.962
Race	.607	.216	7.906	.005	1.835	1.202	2.800
Maternal Cigarette Use	.020	.009	5.124	.024	1.020	1.003	1.037
Home Environment	-.034	.017	3.902	.048	.967	.935	1.000
Sociability	.352	.149	5.609	.018	1.423	1.063	1.904
Constant	-.386	.843	.209	.647	.680		

Table 60. Dichotomous Cigarette Use Outcomes and Age 6 Emotionality

	β	S.E.	Wald	Sig.	OR	95% C.I. for OR	
						Lower	Upper
Gender	-.408	.182	5.039	.025	.665	.466	.950
Race	.659	.215	9.438	.002	1.934	1.270	2.945
Maternal Cigarette Use	.019	.009	4.650	.031	1.019	1.002	1.037
Home Environment	-.028	.017	2.690	.101	.972	.940	1.006
Emotionality	.192	.129	2.214	.137	1.211	.941	1.559
Constant	.222	.786	.080	.778	1.248		

Table 61. Categorical Cigarette Use Outcomes and Age 6 Sociability

	β	S.E.	Wald	Sig.	Cumulative Odds Ratio
Gender	-.472	.175	7.248	.007	.624
Race	.608	.184	10.854	.001	1.837
Maternal Depression	.022	.009	5.959	.015	1.022
Maternal Cigarette Use	.020	.008	6.181	.013	1.020
Sociability	.401	.148	7.373	.007	1.493

F. EFFECTS OF TEMPERAMENT ON SUBSTANCE USE, MODERATED BY GENDER, RACE, OR PUBERTAL STATUS

Interaction terms were added to the reduced models to address Specific Aim 3: To examine whether the effects of childhood temperament are moderated by gender, race, or pubertal status. Tables 62 – 67 show the results of the moderating hypotheses for cigarette use outcomes. Since pubertal status was not associated with cigarette use outcomes, and since temperament at age 10 did not predict any substance use outcomes, no analyses were run for Hypothesis 9: The relationship between temperament and substance use will be moderated by pubertal status.

The Activity by gender interaction was marginally significant for dichotomous cigarette use outcomes, with males exhibiting higher Activity scores, which predicted trying cigarettes by

age 14 (Table 62). No other interactions in either the dichotomous or categorical cigarette use outcomes were significant, or marginally significant (Tables 63 – 67).

Table 62. Dichotomous Cigarette Use Outcomes and Age 6 Activity by Gender Interaction

	β	S.E.	Wald	Sig.	OR
Gender	1.292	.961	1.810	.179	3.641
Race	.630	.216	8.510	.004	1.877
Maternal Cigarette Use	.020	.009	5.018	.025	1.020
Home Environment	-.036	.017	4.438	.035	.964
Activity	.458	.167	7.524	.006	1.582
Activity by Gender	-.455	.246	3.409	.065	.635
Constant	-.623	.854	.531	.466	.536

Table 63. Dichotomous Cigarette Use Outcomes and Age 6 Activity by Race Interaction

	β	S.E.	Wald	Sig.	OR
Gender	-.454	.185	6.050	.014	.635
Race	.835	.961	.756	.385	2.305
Maternal Cigarette Use	.019	.009	4.659	.031	1.019
Home Environment	-.035	.017	4.162	.041	.965
Activity	.275	.160	2.945	.086	1.316
Activity by Race	-.048	.243	.040	.842	.953
Constant	.006	.837	.000	.994	1.006

Table 64. Dichotomous Cigarette Use Outcomes and Age 6 Sociability by Gender Interaction

	β	S.E.	Wald	Sig.	OR
Gender	-.871	1.172	.552	.457	.419
Race	.606	.216	7.874	.005	1.832
Maternal Cigarette Use	.020	.009	5.016	.025	1.020
Home Environment	-.033	.017	3.802	.051	.967
Sociability	.293	.207	1.999	.157	1.340
Sociability by Gender	.122	.296	.169	.681	1.129
Constant	-.167	.994	.028	.866	.846

Table 65. Dichotomous Cigarette Use Outcomes and Age 6 Sociability by Race Interaction

	β	S.E.	Wald	Sig.	OR
Gender	-.396	.182	4.738	.030	.673
Race	.144	1.284	.013	.911	1.154
Maternal Cigarette Use	.020	.009	5.128	.024	1.020
Home Environment	-.034	.017	3.846	.050	.967
Sociability	.315	.179	3.097	.078	1.371
Sociability by Race	.117	.321	.134	.715	1.125
Constant	-.252	.917	.076	.783	.777

Table 66. Categorical Cigarette Use Outcomes and Age 6 Sociability by Gender Interaction

	β	S.E.	Wald	Sig.	Cumulative Odds Ratio
Gender	-1.528	1.173	1.698	.193	.217
Race	.804	.210	14.618	.000	.234
Maternal Cigarette Use	.021	.008	6.584	.010	1.021
Home Environment	-.035	.017	4.328	.037	.966
Sociability	.226	.197	1.325	.250	1.254
Sociability by Gender	.266	.294	.820	.365	1.305

Table 67. Categorical Cigarette Use Outcomes and Age 6 Sociability by Race Interaction

	β	S.E.	Wald	Sig.	Cumulative Odds Ratio
Gender	-.480	.177	7.345	.007	.619
Race	.297	1.236	.058	.810	1.346
Maternal Cigarette Use	.021	.008	6.850	.009	1.021
Home Environment	-.035	.017	4.439	.035	.966
Sociability	.306	.181	2.858	.091	1.358
Sociability by Race	.128	.307	.173	.677	1.137

G. EFFECTS OF TEMPERAMENT ON SUBSTANCE USE, MEDIATED BY PROBLEM BEHAVIORS

The models from the previous section were then used to test H10: The relationship between temperament and substance use will be mediated by problem behaviors at age 10. That is, temperament at age 6 will predict problem behaviors at age 10, which in turn, will predict substance use at age 14.

Problem behaviors at age 10, such as aggression and delinquency, were examined as mediators of the relationship between age 6 temperament measures and cigarette use outcomes. There was no relationship found between age 6 temperament and alcohol, marijuana, or

polysubstance use outcomes. Baron & Kenny's (1981) Causal Steps test was first performed to identify which models might contain a mediating effect.

In the logistic regression models, without controlling for covariates, theft was identified as a partial mediator of the relationship between age 6 activity level and ever use of cigarettes by age 14 (Tables 68 – 70). This partial mediating effect remained when controlling for variables common to both age 6 and 10 predictors of cigarette use (Tables 44 & 45), including gender, race, and maternal cigarette use. Maternal cigarette use at age 6 was used to represent maternal smoking in this model, as the goal of this project was to determine risk factors at the earliest possible age. This partial mediating effect also remained when the quality of the environment at age 6 was included in the models.

Sobel's (1982) Product of Coefficients test was then performed, using the standardized coefficients, to estimate the mediated effect and test its significance. Sobel's test provides a Z-score, which indicates significance when compared to a critical value, $Z = 1.96$, for $p = .05$. None of the Z-scores calculated in these analyses was above 1.96, indicating non-significance. The results for these analyses are found in Table 71.

Table 68. Coefficients for Mediating Hypotheses in Logistic Regression Models for Cigarette Use – Not Controlling for Other Covariates

	X → Y			**X + M → Y**				**X → M**	
	τ	σ_τ	Mediator	τ'	$\sigma_{\tau'}$	β	σ_β	α	σ_α
			Aggression						
Activity	.251**	.115		.199*	.121	.021	.016	1.865**	.331
Sociability	.422**	.143		.400**	.146	.023	.015	.889**	.411
Emotionality	.226*	.123		.171	.134	.020	.016	2.787**	.349
			Status						
Activity				.237**	.118	.365*	.218	.077	.142
Sociability				.442**	.146	.413*	.220	-.180	.167
Emotionality				.211*	.127	.353*	.218	.206	.151
			Theft						
Activity				.216*	.118	.591**	.230	.302**	.151
Sociability				.424**	.146	.619**	.231	.098	.179
Emotionality				.210*	.127	.610**	.230	.163	.157
			Damage						
Activity				.239**	.118	.020	.243	.448**	.166
Sociability				.425**	.145	.044	.243	.216	.196
Emotionality				.221*	.126	.054	.241	.226	.167

* $p \leq .10$

** $p \leq .05$

$X \rightarrow Y$ - Model with the independent variable predicting the outcome

$X + M \rightarrow Y$ - Model with independent and mediator variables predicting the outcome

$X \rightarrow M$ - Model with the independent variable predicting the mediator

τ - Coefficient for X, without controlling for the mediator

σ_τ - Standard deviation of X, without controlling for the mediator

τ' - Coefficient for X, controlling for the mediator

$\sigma_{\tau'}$ - Standard deviation of X, controlling for the mediator

β - Coefficient for M, controlling for X

σ_β - Standard deviation of M, controlling for X

α - Coefficient for X, as a predictor of M

σ_α - Standard deviation of X, as a predictor of M

Table 69. Coefficients for Mediating Hypotheses in Logistic Regression Models for Cigarette Use – Controlling for Covariates Common to Age 6 and 10 Models [a]

	X → Y			**X + M → Y**				**X → M**	
	τ	σ_τ	Mediator	τ'	$\sigma_{\tau'}$	β	σ_β	α	σ_α
			Aggression						
Activity	.260**	.120		.221*	.125	.019	.016	1.712**	.336
Sociability	.366**	.148		.340**	.151	.023	.016	.797**	.413
Emotionality	.241*	.126		.198	.138	.018	.017	2.749**	.346
			Status						
Activity				.258	.123	.591	.230	.054	.149
Sociability				.386**	.151	.616**	.232	-.065	.171
Emotionality				.229*	.130	.581**	.230	.140	.154
			Theft						
Activity				.237**	.123	.712**	.238	.285*	.155
Sociability				.367**	.152	.734**	.239	.130	.181
Emotionality				.229*	.130	.726**	.237	.149	.158
			Damage						
Activity				.249**	.123	.181	.251	.466**	.171
Sociability				.365**	.150	.200	.251	.322	.196
Emotionality				.237*	.130	.224	.250	.178	.168

[a] Race, Gender. Maternal Cigarette Use

* $p \leq .10$

** $p \leq .05$

X → Y - Model with the independent variable predicting the outcome

X + M → Y - Model with independent and mediator variables predicting the outcome

X → M - Model with the independent variable predicting the mediator

τ - Coefficient for X, without controlling for the mediator

σ_τ - Standard deviation of X, without controlling for the mediator

τ' - Coefficient for X, controlling for the mediator

$\sigma_{\tau'}$ - Standard deviation of X, controlling for the mediator

β - Coefficient for M, controlling for X

σ_β - Standard deviation of M, controlling for X

α - Coefficient for X, as a predictor of M

σ_α - Standard deviation of X, as a predictor of M

Table 70. Coefficients for Mediating Hypotheses in Logistic Regression Models for Cigarette Use – Controlling for All Covariates from Age 6 and 10 Models [a]

	X → Y			X + M → Y				X → M	
	τ	σ_τ	Mediator	τ'	$\sigma_{\tau'}$	β	σ_β	α	σ_α
			Aggression						
Activity	.254**	.122		.222	.127	.014	.017	1.672**	.337
Sociability	.352**	.149		.333**	.152	.017	.016	.773*	.412
Emotionality	.192	.129		.158	.141	.014	.017	2.734**	.349
			Status						
Activity				.253**	.125	.569**	.232	.021	.150
Sociability				.378**	.153	.594**	.234	-.094	.171
Emotionality				.177	.133	.558**	.232	.139	.156
			Theft						
Activity				.225*	.126	.767**	.245	.308**	.158
Sociability				.353**	.153	.786**	.246	.161	.185
Emotionality				.173	.133	.783**	.244	.172	.162
			Damage						
Activity				.243**	.125	.174	.254	.421**	.173
Sociability				.356**	.152	.192	.253	.282	.197
Emotionality				.185	.133	.210	.252	.204	.172

[a] Race, Gender. Maternal Cigarette Use, Quality of the Home Environment

* $p \leq .10$

** $p \leq .05$

X → Y - Model with the independent variable predicting the outcome

X + M → Y - Model with independent and mediator variables predicting the outcome

X → M - Model with the independent variable predicting the mediator

τ - Coefficient for X, without controlling for the mediator

σ_τ - Standard deviation of X, without controlling for the mediator

τ' - Coefficient for X, controlling for the mediator

$\sigma_{\tau'}$ - Standard deviation of X, controlling for the mediator

β - Coefficient for M, controlling for X

σ_β - Standard deviation of M, controlling for X

α - Coefficient for X, as a predictor of M

σ_α - Standard deviation of X, as a predictor of M

Table 71. Z-Scores Estimating the Significance of Theft as a Mediator of the Relationship Between Age 6 Activity and Dichotomous Cigarette Use

	No Covariates	Controlling for covariates common to age 6 & 10 models	Controlling for all covariates in age 6 & 10 models
Z-score	1.578	1.566	1.655

In the ordinal regression analyses, none of the models met Baron & Kenny's (1981) criteria for a mediating effect. The data for these analyses can be found in the Appendix Tables 22 - 25. In the models not controlling for any covariates, aggression was tested as a mediator of Sociability, since aggression marginally predicted cigarette outcomes when controlling for Sociability. Again, theft was tested as a mediator of Activity, even though Activity only marginally predicted cigarette outcomes. The same was true for the theft/Activity model when controlling for variables common to age 6 and 10 predictors (gender, race, maternal cigarette use). The mediating effects were not significant in these models either, as none of the Z-scores were greater than 1.96.

H. GROUP ANALYSES

The results showing that certain variables predicted frequency of use for cigarettes, alcohol, and marijuana, as well as the number of substances initiated by age 14, raised the question of where these differences lie. This last set of analyses, which was not included in the original hypotheses, examined predictors of initiation versus predictors of escalation of substance use. In order to distinguish initiation from escalation, children who endorsed substance use during the age 10 assessment were dropped from the specific substance outcome for these analyses. These children included 36 children who had smoked a cigarette by age 10 for the cigarette outcome, 20 children who had more than a sip or taste of alcohol by age 10 for the alcohol outcome, and 52 children who had initiated use of any substance by age 10 for the polysubstance outcome. Thus, cigarette analyses were conducted only with children who had not smoked a cigarette by the age 10 assessment, alcohol analyses were conducted only with

children who had not had more than a sip or taste of alcohol by the age 10 assessment, and polysubstance use analyses were conducted only with children who had not initiated any substance use by the age 10 assessment. No children endorsed marijuana use by age 10, so these analyses were conducted with the full sample.

Logistic regression analyses were conducted to compare the groups from the categorical analyses. To examine initiation of cigarettes, alcohol, and marijuana, those who had not used a substance were compared to those classified as non-regular users. To examine escalation of cigarette, alcohol, and marijuana use, non-regular users were compared to regular users. For the polysubstance use outcome, those who had not initiated any substance use were compared to those who had initiated use of a single substance to examine initiation, and those who had used a single substance were compared to those who had used two or more to examine escalation.

These analyses were conducted in a manner similar to the previous analyses. Bivariate analyses were conducted as a data reduction step. The models were then built hierarchically, following the blocks outlined previously, using variables with p-values $< .10$ in the bivariate analyses.

In the bivariate analyses, predictors of the initiation of cigarette use with p-values $< .10$ included gender, sociability, and status and theft offenses (Table 72). For age 6 variables, gender and sociability were entered into the model. Since gender was not significant ($p = .075$), only increased sociability remained a significant predictor of the initiation of cigarette use (Table 73). For age 10 variables, gender was added first, followed by status offenses, which was no longer significant once theft offenses were included in the model, leaving Caucasian race and presence of theft offenses as significant predictors of the initiation of cigarette use (Table 74).

Table 72. Bivariate Predictors of the Initiation of Cigarette Use by age 14

	Age 6		Age 10	
	p	OR	p	OR
Gender	.090*	.715	.090*	.715
Status Offenses	N/A	N/A	.087*	1.513
Theft Offenses	N/A	N/A	.036**	1.714
Sociability	.019**	1.470	NS	NS

* $p < .10$
** $p \leq .05$
NS – Not significant
N/A – Not assessed

Table 73. Age 6 Predictors of the Initiation of Cigarette Use by Age 14

	β	S.E.	Wald	Sig.	OR	95% CI for OR	
						Lower	Upper
Sociability	.385	.164	5.517	.019	1.470	1.066	2.027
Constant	-2.083	.649	10.292	.001	.125		

Table 74. Age 10 Predictors of the Initiation of Cigarette Use by Age 14

	β	S.E.	Wald	Sig.	OR	95% CI for OR	
						Lower	Upper
Gender	-.468	.205	5.204	.023	.626	.419	.936
Theft	.608	.261	5.420	.020	1.836	1.101	3.063
Constant	-.456	.145	9.878	.002	.634		

Predictors of the escalation of cigarette use with p-values < .10 included race, child depression, prenatal cigarette and alcohol exposure, current maternal cigarette use, and maternal use of other drugs when their child was 6 years old (Table 75). For age 6 variables, race was entered into the model, followed by prenatal cigarette and alcohol exposure, which were not significant when controlling for race. Current maternal cigarette and other drug use where then added, but again, they did not remain significant when controlling for race. The one significant predictor of escalation of cigarette use at age 6 was Caucasian race (Table 76). For age 10 variables, race was entered first, followed by maternal cigarette use, then child's depression. Child's depression was not significant, leaving Caucasian race and maternal cigarette use as predictors of the escalation of cigarette use (Table 77).

Table 75. Bivariate Predictors of the Escalation of Cigarette Use by age 14

	Prenatal		Age 6		Age 10	
	p	OR	p	OR	p	OR
Race	.000**	3.830	.000**	3.830	.000**	3.830
Child Depression	N/A	N/A	N/A	N/A	.088*	1.031
Maternal Cigarette Use	.028**	1.028	.007**	1.036	.001**	1.043
Maternal Alcohol Use	.066*	1.321	NS	NS	NS	NS
Maternal Other Drug Use	NS	NS	.008**	4.768	NS	NS

* $p < .10$
** $p \leq .05$
NS – Not significant
N/A – Not assessed

Table 76. Age 6 Predictors of the Escalation of Cigarette Use by age 14

	β	S.E.	Wald	Sig.	OR	95% CI for OR	
						Lower	Upper
Race	1.343	.336	15.928	.000	3.830	1.980	7.405
Constant	-1.769	2.79	40.117	.000	.170		

Table 77. Age 10 Predictors of the Escalation of Cigarette Use by age 14

	β	S.E.	Wald	Sig.	OR	95% CI for OR	
						Lower	Upper
Race	1.047	.360	8.443	.004	2.849	1.406	5.774
Maternal Cig. Use	.028	.014	4.040	.044	1.028	1.001	1.056
Constant	-1.938	.300	41.858	.000	.144		

Predictors of the initiation of alcohol use with p-values < .10 included race, IQ at 6 and 10, maternal cigarette use, maternal depression and anxiety when their child was 6 years old, quality of the home environment at 6 and 10, family income, drug/alcohol problems in the man in the household when the child was 6 years old, child's aggression at age 10, and theft and damage offenses (Table 78). Prenatal cigarette exposure, maternal cigarette use, quality of the home environment, family income, and drug/alcohol problems in the man in the household were not significant when controlling for race. For age 6 variables, race was entered first, followed by maternal depression, which was no longer significant when maternal anxiety was entered into the model. Child's IQ was entered last, leaving Caucasian race, decreased maternal anxiety, and

increased child IQ as significant predictors of the initiation of alcohol use by age 14 (Table 79). For age 10 variables, race was entered first, followed by child's IQ, aggression, theft and damage offenses. Child's aggression was no longer significant once the delinquency variables were included in the model, leaving Caucasian race, increased child IQ, and presence of theft and damage offenses as significant predictors of the initiation of alcohol use (Table 80).

Table 78. Bivariate Predictors of the Initiation of Alcohol Use by age 14

	Prenatal		**Age 6**		**Age 10**	
	p	OR	p	OR	p	OR
Race	.822	.001**	.822	.001**	.822	.001**
Composite IQ	N/A	N/A	.000**	1.033	.000**	1.043
Maternal Cigarette Use	.067*	1.019	.023**	1.023	.021**	1.024
Maternal Depression	N/A	N/A	.049**	.975	NS	NS
Maternal Anxiety	N/A	N/A	.008**	.923	NS	NS
Quality of the Home Env.	N/A	N/A	.003**	1.068	.040**	1.102
Average Family Income	N/A	N/A	.022**	1.000	.051**	1.000
Drug/Alc Prob. In Man in HH	N/A	N/A	.068*	.362	NS	NS
Child's Aggression	N/A	N/A	NS	NS	.092*	1.034
Theft Offenses	N/A	N/A	N/A	N/A	.013**	2.038
Damage Offenses	N/A	N/A	N/A	N/A	.025**	1.921

* $p < .10$
** $p \leq .05$
NS – Not significant
N/A – Not assessed

Table 79. Age 6 Predictors of the Initiation of Alcohol Use by Age 14

	β	**S.E.**	**Wald**	**Sig.**	**OR**	**95% CI for OR**	
						Lower	**Upper**
Race	.680	.262	6.732	.009	1.973	1.181	3.297
Maternal Anxiety	-.077	.031	6.006	.014	.926	.871	.985
Composite IQ	.022	.009	5.423	.020	1.022	1.003	1.041
Constant	-2.485	1.044	5.665	.017	.083		

Table 80. Age 10 Predictors of the Initiation of Alcohol Use by Age 14

	β	S.E.	Wald	Sig.	OR	95% CI for OR	
						Lower	Upper
Race	.772	.271	8.105	.004	2.164	1.272	3.681
Composite IQ	.036	.012	9.345	.002	1.037	1.013	1.061
Theft Offenses	.700	.329	4.536	.033	2.013	1.057	3.833
Damage Offenses	.675	.334	4.095	.043	1.965	1.021	3.780
Constant	-5.308	1.105	23.091	.000	.005		

Predictors of the escalation of alcohol use with p-values < .10 included gender, Child's IQ at age 10, family income at age 6, and drug/alcohol problems in the man in the household when the child was 6 years old (Table 81). For age 6 variables, neither family income nor drug/alcohol problems in the man in the household remained significant when controlling for race. Therefore, female gender was the only remaining significant predictor of escalated alcohol use by age 14 (Table 82). For age 10 variables, child's IQ was not significant when controlling for gender, again leaving female gender as the only remaining significant predictor of escalated alcohol use by age 14 (Table 82).

Table 81. Bivariate Predictors of the Escalation of Alcohol Use by age 14

	Age 6		Age 10	
	p	OR	p	OR
Gender	.006**	.432	.006**	.432
Composite IQ	NS	NS	.063*	.975
Family Income	.052*	1.000	NS	NS
Drug/Alc Prob. in Man in HH	.088*	3.029	NS	NS

* $p < .10$
** $p \leq .05$
NS – Not significant
N/A – Not assessed

Table 82. Age 6 and 10 Predictors of the Escalation of Alcohol Use by age 14

	β	S.E.	Wald	Sig.	OR	95% CI for OR	
						Lower	Upper
Gender	-.840	.306	7.561	.006	.432	.237	.786
Constant	.350	.199	3.084	.079	1.419		

Predictors of the initiation of marijuana use with p-values < .10 included prenatal cigarette and marijuana exposure, maternal cigarette, cocaine, other drug use, and depression when their child was 6 years old, child IQ, and presence of status offenses (Table 83). For age 6 variables, prenatal exposures were added first, followed by maternal depression, cocaine, and other drug use, then child's IQ. Maternal cocaine and other drug use were not significant when prenatal exposure and maternal depression were in the model, and maternal depression was not significant when controlling for child's IQ. This left a model including prenatal cigarette and marijuana exposure and increased child IQ as predictors of the initiation of marijuana use by age 14 (Table 84). Since maternal cigarette use at age 10 was not a significant predictor of marijuana initiation, and because prenatal exposure had a greater effect size and lower p-value than maternal cigarette use at age 6, prenatal cigarette exposure was kept in the age 6 model. For age 10 variables, prenatal exposures were added first, followed by child's IQ. Status offenses were not significant after controlling for prenatal exposure and IQ, leaving prenatal cigarette and marijuana exposure, and increased child IQ as predictors of marijuana initiation by age 14 (Table 85).

Table 83. Bivariate Predictors of the Initiation of Marijuana Use by age 14

	Prenatal		**Age 6**		**Age 10**	
	p	OR	p	OR	p	OR
Maternal Cigarette Use	.015**	1.025	.024**	1.024	NS	NS
Maternal Marijuana Use	.051*	1.246	NS	NS	NS	NS
Maternal Cocaine Use	NS	NS	.095*	1.925	NS	NS
Maternal Other Drug Use	NS	NS	.038**	2.538	NS	NS
Maternal Depression	N/A	N/A	.080*	.976	NS	NS
Composite IQ	N/A	N/A	.015**	1.023	.001**	1.037
Status Offenses	N/A	N/A	N/A	N/A	.084*	1.662

* $p < .10$
** $p \leq .05$
NS – Not significant
N/A – Not assessed

Table 84. Age 6 Predictors of the Initiation of Marijuana Use by Age 14

	β	S.E.	Wald	Sig.	OR	95% CI for OR	
						Lower	Upper
Prenatal Cigarettes	.023	.011	4.481	.034	1.023	1.002	1.045
Prenatal Marijuana	.283	.120	5.604	.018	1.328	1.050	1.679
Composite IQ	.025	.010	7.159	.007	1.026	1.007	1.045
Constant	-4.322	.932	21.488	.000	.013		

Table 85. Age 10 Predictors of the Initiation of Marijuana Use by Age 14

	β	S.E.	Wald	Sig.	OR	95% CI for OR	
						Lower	Upper
Prenatal Cigarettes	.022	.011	4.014	.045	1.022	1.000	1.044
Prenatal Marijuana	.267	.119	5.057	.025	1.306	1.035	1.648
Composite IQ	.037	.011	10.672	.001	1.038	1.015	1.062
Constant	-5.373	1.105	23.626	.000	.005		

Predictors of the escalation of marijuana use with p-values < .10 included maternal depression, maternal anxiety when their child was 10 years old, use of physical discipline at age 6, quality of the home environment at age 6, child IQ, child's aggression at age 10, and sociability at age 6 (Table 86). For age 6 variables, maternal depression was entered first, followed by physical discipline, quality of the home environment, child's IQ, and sociability. Quality of the home environment was no longer significant when controlling for maternal depression and physical discipline, and physical discipline was no longer significant when controlling for child's IQ. This left increased maternal depression, decreased child IQ, and increased sociability as significant predictors of the escalation of marijuana use by age 14 (Table 87). For age 10 variables, maternal depression was entered first, followed by maternal anxiety, which was not significant controlling for maternal depression. Child's IQ was added, followed by child's aggression, which was not significant controlling for maternal depression and child IQ. This left a model including increased maternal depression and decreased child IQ as predictors of the escalation of marijuana use by age 14 (Table 88).

Table 86. Bivariate Predictors of the Escalation of Marijuana Use by age 14

	Age 6		Age 10	
	p	OR	p	OR
Maternal Depression	.017**	1.045	.004**	1.054
Maternal Anxiety	NS	NS	.078*	1.062
Physical Discipline	.050**	1.922	NS	NS
Quality of the Home Env.	.081*	.950	NS	NS
Composite IQ	.001**	.958	.000**	.943
Child's Aggression	NS	NS	.020**	1.066
Sociability	.067*	1.632	NS	NS

* $p < .10$
** $p \leq .05$
NS – Not significant
N/A – Not assessed

Table 87. Age 6 Predictors of the Escalation of Marijuana Use by age 14

	β	S.E.	Wald	Sig.	OR	95% CI for OR	
						Lower	Upper
Maternal Depression	.039	.020	3.883	.049	1.040	1.000	1.081
Composite IQ	-.040	.014	8.532	.003	.960	.935	.987
Sociability	.642	.284	5.122	.024	1.901	1.090	3.316
Constant	-.074	1.869	.002	.968	.928		

Table 88. Age 10 Predictors of the Escalation of Marijuana Use by age 14

	β	S.E.	Wald	Sig.	OR	95% CI for OR	
						Lower	Upper
Maternal Depression	.044	.019	5.233	.022	1.045	1.006	1.085
Composite IQ	-.055	.016	12.180	.000	.947	.918	.976
Constant	3.440	1.663	4.278	.039	31.184		

Predictors of the initiation of any substance use with p-values < .10 included race, a family history of drug/alcohol problems, maternal cigarette use when their child was 6 years old, drug/alcohol problems in the man in the household when the child was 6 years old, family income when the child was 10 years old, child's anxiety at age 10, theft offenses, and activity and sociability at age 6 (Table 89). For age 6 variables, race and family history were added first, followed by maternal cigarette use, and drug/alcohol problems in the man in the household. Family history, maternal cigarette use, and drug/alcohol problems in the man in the household

were not significant after controlling for race. Sociability and activity were tested in the model separately, controlling for race. Increased sociability and Caucasian race remained significant predictors of the use of any substance by age 14 (Table 90). For age 10 variables, race and family history were entered first, followed by family income, child's anxiety, and theft offenses. Family history and average family income were not significant controlling for race, leaving Caucasian race, increased child anxiety, and presence of theft offenses as predictors of ever having tried any substance by age 14 (Table 91).

Table 89. Bivariate Predictors of the Initiation of Substance Use by age 14

	Age 6		**Age 10**	
	p	OR	p	OR
Race	.007**	1.886	.007**	1.886
Family History of Drg/Alc Prob	.090*	1.719	.090*	1.719
Maternal Cigarette Use	.051*	1.022	NS	NS
Drug/Alc Probs in Man in HH	.041	.308	NS	NS
Family Income	NS	NS	.041**	1.000
Child's Anxiety	N/A	N/A	.046**	1.039
Theft Offenses	N/A	N/A	.003**	2.662
Activity	.092*	1.301	NS	NS
Sociability	.002**	1.857	NS	NS

* $p < .10$
** $p \leq .05$
NS – Not significant
N/A – Not assessed

Table 90. Age 6 Predictors of the Initiation of Substance Use by Age 14

	β	**S.E.**	**Wald**	**Sig.**	**OR**	**95% CI for OR**	
						Lower	**Upper**
Race	.517	.246	4.405	.036	1.677	1.035	2.717
Sociability	.577	.205	7.899	.005	1.780	1.191	2.661
Constant	-3.071	.817	14.127	.000	.046		

Table 91. Age 10 Predictors of the Initiation of Substance Use by Age 14

	β	S.E.	Wald	Sig.	OR	95% CI for OR	
						Lower	Upper
Race	.767	.260	8.681	.003	2.154	1.293	3.589
Child Anxiety	.045	.020	4.739	.029	1.046	1.004	1.088
Theft Offenses	.956	.350	7.441	.006	2.600	1.309	5.167
Constant	-1.512	.293	26.594	.000	.221		

Predictors of the escalation of substance use with p-values < .10 included prenatal cigarette, alcohol, and marijuana exposure, maternal alcohol use, drug/alcohol problems in the man in the household when the child was 6 years old, and maternal cigarette and alcohol use and family income when the child was 10 years old (Table 92). For age 6 variables, prenatal cigarette, alcohol, and marijuana exposure were entered first, followed by alcohol/drug problems in the man in the household. Prenatal alcohol exposure was included in this model, as opposed to current maternal alcohol use, since current use was marginally significant (p = .098). Prenatal alcohol exposure was the only predictor that remained significant (Table 93).

For age 10 variables, prenatal cigarette, alcohol, and marijuana exposure were entered first, followed by current maternal cigarette use and family income. Again, prenatal alcohol exposure was included in this model, as opposed to current maternal alcohol use, since current use was marginally significant (p = .072). Prenatal alcohol exposure was the only predictor that remained significant (Table 93).

Table 92. Bivariate Predictors of the Escalation of Substance Use by age 14

	Prenatal		Age 6		Age 10	
	p	OR	p	OR	p	OR
Maternal Cigarette Use	.056*	1.022	NS	NS	.072*	1.020
Maternal Alcohol Use	.032**	1.398	.098*	1.122	.072*	1.162
Maternal Marijuana Use	.052*	1.322	NS	NS	NS	NS
Drug/Alc Probs in Man in HH	N/A	N/A	.056*	3.051	NS	NS
Family Income	N/A	N/A	NS	NS	.063*	1.000

* $p < .10$
** $p \leq .05$
NS – Not significant
N/A – Not assessed

Table 93. Age 6 and 10 Predictors of the Escalation of Substance Use by age 14

	β	S.E.	Wald	Sig.	OR	95% CI for OR	
						Lower	Upper
Prenatal Alcohol	.335	.156	4.600	.032	1.398	1.029	1.899
Constant	.334	.139	5.799	.016	1.396		

I. SUMMARY

Increased activity and increased sociability at age 6 predicted dichotomous cigarette use outcomes, even when controlling for other significant predictors of cigarette use. Increased sociability also predicted categorical cigarette use outcomes, even after controlling for other covariates, although multiple comparisons tests showed that sociability did not distinguish non-regular from regular cigarette users. Emotionality did not predict any substance use outcomes, and activity and sociability did not predict dichotomous alcohol or marijuana outcomes, or any categorical use outcomes. There were no significant moderating or mediating effects found in these analyses.

Further investigation into the predictors of dichotomous versus categorical substance use lead to an examination of the predictors of initiation versus escalation of substance use. For

cigarette use, gender predicted both dichotomous and categorical cigarette use outcomes, but female gender only predicted the initiation of cigarette use. It did not distinguish between non-regular and regular cigarette users. Race significantly predicted dichotomous and categorical cigarette use outcomes, but did not predict initiation. Caucasian race did predict escalation. Maternal cigarette use significantly predicted dichotomous and categorical cigarette use groups, but did not predict initiation. Increasing maternal cigarette use did predict escalation. Committing theft offenses at age 10 predicted dichotomous cigarette groups and initiation. It did not predict frequency of use or escalation. While sociability predicted dichotomous and categorical cigarette use, it only predicted the initiation of cigarette use and did not distinguish regular from non-regular smokers.

For alcohol use, gender did not predict dichotomous or categorical outcomes, nor did it predict initiation of alcohol use. However, female gender did predict higher frequency of use. Race was a significant predictor of dichotomous and categorical alcohol outcomes, but Caucasian race only predicted initiation of alcohol use. It did not predict escalation. Decreased maternal anxiety when the child was 6 years old predicted dichotomous alcohol use and initiation of use. It did not predict frequency of use. Increased child IQ at ages 6 and 10 predicted dichotomous alcohol outcomes and initiation of alcohol use. However, it did not distinguish non-regular users from regular users. Committing theft offenses was a significant predictor of dichotomous and categorical alcohol outcomes. Theft offenses did predict initiation, but not escalation. While damage offenses did not significantly predict dichotomous or categorical alcohol outcomes, it did predict alcohol initiation.

For marijuana use, prenatal cigarette and marijuana exposure predicted dichotomous marijuana groups and the initiation of marijuana use. They did not predict frequency of use.

While child IQ did not predict dichotomous or categorical marijuana outcomes, it did distinguish initiation and escalation. Increased IQ predicted the initiation of marijuana use, while decreased IQ predicted the escalation of use. While maternal depression did not predict dichotomous or categorical marijuana use, increased maternal depression when their child was 6 or 10 years old predicted the escalation of marijuana use. Sociability also did not predict dichotomous or categorical marijuana use, but increased sociability was a significant predictor of the escalation of marijuana use.

For polysubstance use, none of the predictors of initiation or escalation were in the final reduced models for substance use (Tables 56 & 57). However, Caucasian race, increased sociability at age 6, and increased child anxiety and theft offenses predicted initiation of any substance use, while increased prenatal alcohol exposure predicted the escalation of use.

These results have shown that there are common and unique risk factors associated with the use of specific substances at age 14. They also help tease out which factors are associated with the initiation of a substances and which factors are associated with increasing frequency of use of those substances.

V. DISCUSSION

A. INTRODUCTION

This project investigated whether temperament, as measured in childhood at ages 6 and 10, predicted child substance use outcomes at age 14. This project offered a unique opportunity to explore the usefulness of childhood temperament measures in predicting adolescent substance use, while simultaneously controlling for other variables related to substance use outcomes. The aims of this project were to identify ages 6 and 10 correlates of substance use in early adolescence, examine the relationship between childhood temperament and child substance use, and to examine possible mediating and moderating pathways during childhood that may affect the rates of substance use at age 14.

B. SUMMARY OF RESULTS

At both ages 6 and 10, correlates of child substance use were defined, the separate domains were examined as predictors, and the direct effect of temperament was re-examined while controlling for variables from other domains that were determined to be significant predictors of child substance use at age 14. This project has shown that broad dimensions of temperament measured at age 6 were useful in identifying children at risk for the early initiation

of substance use, particularly cigarettes. Examination of initiation versus escalation of use has also shown that some variables are unique to risk for initiation, while others are unique predictors of escalation.

Higher sociability and higher activity ratings from the EAS at age 6 predicted children's smoking status at age 14. Children with higher sociability or activity scores at age 6 were more likely to have tried smoking a cigarette by age 14 than those with lower scores. Female gender, Caucasian race, higher levels of maternal smoking, and poorer quality of the home environment, all measured at age 6, were also shown to predict this dichotomous smoking status. Higher activity and higher sociability scores continued to predict smoking a cigarette by age 14 when controlling for gender, race, maternal cigarette use, and quality of the home environment.

Increased sociability at age 6 also predicted level of cigarette use at age 14 (no cigarette use, < every/almost every day, ≥ every/almost every day). Female gender, Caucasian race, increased maternal smoking, and increased maternal depression at 6 years were significant predictors of categorical cigarette use outcomes. Sociability remained a significant predictor of categorical cigarette outcomes when controlling for other significant covariates. However, multiple comparisons tests showed that the mean sociability scores for the non-regular smokers were not significantly different than the mean sociability scores for the regular smokers. These results were confirmed by the initiation versus escalation analyses, which showed that increased sociability at age 6 predicted the initiation of cigarette use by age 14. Female gender and committing theft offenses at age 10 also predicted the initiation of cigarette use, while Caucasian race and increasing levels of maternal cigarette use predicted the escalation of use from non-regular to daily/almost daily cigarette use.

Activity, sociability, and emotionality were also tested as predictors of alcohol, marijuana, and polysubstance use. Temperament measures were examined as predictors of both dichotomous (never or ever tried more than a sip or taste of alcohol, never or ever tried marijuana) and categorical (never used, < once/month, ≥ once/month) alcohol and marijuana use. However, none of the temperament constructs examined in these analyses were significant predictors of either alcohol or marijuana outcomes. Temperament also did not predict polysubstance use. However, the initiation versus escalation analyses revealed some slightly different results. While increased sociability at age 6 did not predict dichotomous or categorical alcohol, marijuana, or polysubstance use outcomes, it did predict the initiation of the use of any substance, as well as the escalation of marijuana use from non-regular use to at least monthly use.

Other results from the initiation versus escalation analyses showed that Caucasian race, decreased maternal anxiety when the child was 6 years old, increased child IQ at ages 6 and 10, and theft and damage offenses at age 10 predicted initiation of alcohol use, while female gender predicted escalation to a higher frequency of use. Prenatal cigarette and marijuana exposure and increased IQ predicted the initiation of marijuana use, while decreased IQ and increased maternal depression when their child was 6 or 10 years old were significant predictors of escalation to regular marijuana use. Caucasian race and increased child anxiety and theft offenses at age 10 predicted initiation of any substance use, while increased prenatal alcohol exposure predicted the escalation to the use of two or more substances.

Finally, moderating and mediating hypotheses were tested. It was hypothesized that the relationships between childhood temperament and substance use in early adolescence would be moderated by race, gender, and pubertal status. It was also hypothesized that the relationship

between temperament and substance use would be mediated by child problem behaviors, such as aggression and delinquency. The relationships between activity or sociability and cigarette use outcomes were not moderated by race or gender. That is, the relationship between temperament and substance use did not differ between males and females, or between African-Americans and Caucasians. Since early pubertal maturation was only significant as a predictor of categorical alcohol outcomes, and temperament did not predict alcohol use in these analyses, pubertal status was not examined as a moderator.

Problem behaviors, such as aggression and delinquency, were examined as mediators of the relationships between activity or sociability and cigarette use. Theft offenses met Baron and Kenny's criteria as a mediator of the relationship between activity and cigarette use (Baron & Kenny, 1986; Judd & Kenny, 1981). That is, the effect of activity on cigarette use appeared to be explained by theft offenses. However, Sobel's (1982) Product of Coefficients test showed that this mediating relationship was not significant. Aggression also met Baron and Kenny's criteria as a mediator of the relationship between sociability and polysubstance use, but Sobel's (1982) Product of Coefficients test showed that this mediating relationship was not significant.

This project has also shown that there are different childhood predictors for each substance. Many studies focus on a single substance, and some use a composite of multiple substances, which may bias the sample towards cigarette users. This study used one cohort to examine a broad range of childhood predictors of early initiation of the three most commonly used substances in adolescence, and found differential prediction between substances.

C. RELATION TO EXISTING LITERATURE

These analyses partially confirmed Hypothesis 1: Temperament, measured at ages 6 and 10, will significantly predict substance use at age 14, by showing that activity and sociability at age 6 were predictors of cigarette use. These results support previous evidence for the relationship between activity level and substance use, but conflict with some of the evidence regarding sociability. While the magnitudes of the effects from this project were modest (.25 - .57 for parameter estimates, 1.3 – 1.9 for odds ratios), they were consistent with other research examining temperament and personality variables as predictors of substance use. Other longitudinal studies examining temperament and adolescent substance use have shown parameter estimates for temperament dimensions ranging from .11 - .37 and odds ratios from 1.2 – 2.2 (Caspi et al., 1997; Masse & Tremblay, 1997; Niemela et al., 2006; Wills, DuHamel, & Vaccaro, 1995).

Temperamental activity level in infancy, late childhood, and adolescence has consistently been implicated as a risk factor for substance use (Biederman et al., 1998; De Obaldia & Parsons, 1984; Kramer & Loney, 1981; Tarter et al., 1990; Weiss & Hechtman, 1986; Wills et al., 1995, 1998, 2001). This project confirms that this relationship is maintained when activity level is measured in early childhood and extends the existing literature to show that temperamental activity level in early childhood predicts substance use in early adolescence. While many studies have examined temperament, particularly activity level, in relation to substance use in adolescence and adulthood, few, if any, examined temperamental activity levels as a risk factor for the early onset of substance use. The findings from this study are unique in

that they show that temperamental activity level is a risk factor for the use of cigarettes by age 14, while simultaneously considering risk factors from multiple domains. While a high level of activity itself is not necessarily a negative quality, it may relate to an underlying vulnerability pathway. For some children, high activity levels may serve as a marker of underlying behavioral disinhibition that includes impulsivity, inattentiveness, and other measures of behavioral undercontrol that are known to predict later substance use problems (Tarter et al., 2003).

Previous literature on the relationship between sociability and substance use has reported mixed results. Some researchers have shown that increased sociability is related to increased substance use. Molina, Chassin, and Curran (1994) found that increased sociability was related to substance use outcomes for children of alcoholic parents. Engels et al. (2006) have recently shown that the highest levels of smoking and drinking were found in adolescents who scored high on peer-rated sociability in a sample of early and mid-adolescents. This project extends these findings by showing that increased sociability is a risk factor for cigarette use by age 14. It also extends Molina, Chassin, and Curran's (1994) findings by replicating their results from a sample of children of alcoholics in a more generalizable cohort. The relationship between sociability and cigarettes remained significant when considering variables from other domains.

Others have focused on sociability as an aspect of difficult temperament. Decreased sociability is also often thought of as an aspect of difficult temperament (Buss & Plomin, 1984; Thomas & Chess, 1977, 1982), which has been associated with substance use (Giancola and Mezzich, 2003; Lerner & Vicary, 1984). In the former study, low sociability was defined as an aspect of difficult temperament. When examining sociability, specifically, as a risk factor for substance use, Caspi et al. (1997) found that lower social closeness at age 18 predicted

alcoholism at age 21. However, Wills et al. (1998, 2001) showed that sociability was not a significant predictor of substance use in adolescence.

Antisocial behavior has also been shown to be associated with substance use in later adolescence (Feldhusen, Thurston, & Benning, 1973; Shedler & Block, 1990) and adulthood (Ohannessian, Stabenau, & Hesselbrock, 1995). Sociability is a tendency to like being around people (Buss & Plomin, 1984; Thomas & Chess, 1982), while antisocial behavior reflects behaviors that deviate from social norms and show disregard for the rights of others (Hanrahan, 2006). While antisocial behavior and temperamental sociability are not the same construct, they may be related. Children's difficult temperament is associated with increased risk of antisocial behavior (Calkins et al., 1999; Cummings, Davies, & Campbell, 2000), and Graham and Stevenson (1987) have conceptualized the extremes of the temperament domains as risk factors for specific disorders, such that high emotionality serves as a precursor for later affective disorders, high activity levels for hyperactivity syndromes, such as ADHD, and low sociability for later antisocial behavior.

The difference in the results between antisocial behavior and sociability may be due to the timing of the substance use. While antisocial behavior may be a predictor of general substance use in later adolescence and adulthood, high levels of sociability may be a risk factor for substance use in early adolescence, as substance use at this age is conceptualized as a peer group phenomenon (Ennett et al., 2006). The difference in the results for sociability versus antisocial behavior as a risk factor for substance use may have also been influenced by the U-shaped distribution of the sociability dimension. Various studies have found that both extremes of the sociability dimension increase risk for substance use. The sample used in this project was more representative of the general population than a clinical sample, and therefore less likely to

have captured the extreme ends of the sociability dimension. This sample was also young, with sociability measured at ages 6 and 10, and may not have had time to develop more extreme antisocial behaviors.

In this study, increased sociability predicted the initiation of cigarette use. Sociability is generally viewed as a positive trait. However, one possible mechanism that may explain the relationship between increased sociability and substance use is mediation through peer affiliation. Children who are more social probably have more friends. Given the prevalence of substance use in adolescence, the more friends a child has, the greater the likelihood of affiliating with substance using peers, which is a powerful predictor of substance use (Barnow et al., 2002; Hawkins, Catalano, & Miller, 1992).

Another possible mechanism that may explain the relationship between increased sociability and substance use is moderation by impulsivity, a variable that was not included in this project. Children who are highly sociable are likely to participate in more social situations. Social children who are also more impulsive may be at increased risk for experimentation, since impulsivity is associated with substance use (Tcheremissine et al., 2003). For example, Marshal, Molina and Pelham (2003) showed that adolescents with childhood ADHD, who are by definition impulsive, were more likely to affiliate with peers who use drugs and alcohol. Thus, although the Marshal et al. study used a clinical sample, it illustrated the point that sociability and disinhibition may be a particularly dangerous mix in adolescence. Testing this mechanism, which was beyond the scope of the current project, would show whether this mechanism would support the findings of this study.

Hypotheses 3 – 5: Variables in the environmental/demographic, child, and maternal domains (respectively), will be associated with substance use at age 14, were also confirmed by

these analyses. This project has shown that environmental/demographic variables, such as race, gender, and quality of the home environment, child characteristics, such as delinquency, IQ, aggression, and early pubertal maturation, and maternal characteristics, such as cigarette, cocaine, and marijuana use, depression, and anxiety, all predicted child substance use at age 14. These findings support previous literature that has found that variables from multiple domains all contribute to the prediction of substance use (Donovan, 1996; Jessor, Chase, & Donovan, 1980). Reviews of risk factors for substance use consistently show that genetic/biological, environmental, interpersonal, individual, and familial factors contribute to the risk for substance use (Hawkins, Catalano, & Miller, 1992; Hawkins et al., 1997; Newcomb, 1995; Weinberg, 2001). These other domains must be considered when examining specific variables as risk factors for substance use.

Hypothesis 6: The direct effect of temperament will remain when other characteristics of the child, the mother, and the environment are entered into the model, was also confirmed in these analyses by showing that activity and sociability at age 6 remained significant predictors of the dichotomous cigarette outcome, when controlling for other relevant variables. These findings extend previous literature, which showed that temperament characteristics predicted substance use, but did not control for other covariates (Lerner & Vicary, 1984). One of the major strengths of this study was the ability to simultaneously consider other domains relevant to substance use. The findings from this project also extend the relationship between temperament and substance use to include predictability from early childhood to early adolescence.

Hypotheses 7 – 9: The relationships between temperament and substance use will be moderated by gender, race, and pubertal status, were not confirmed. Gender, race, and pubertal status did not moderate the relationship between temperament and substance use. Hypothesis 7

was proposed because there was evidence of gender differences in temperament, specifically in regards to activity and affect, with males exhibiting higher activity levels, and females exhibiting less emotionally volatile responses, and greater positive affect (see review in Else-Quest et al., 2006). Hypothesis 8 was proposed because there were racial differences in the mean temperament scores in preliminary analyses of these data, with African-Americans showing significantly lower levels of sociability than Caucasians at ages 6 and 10, and African-American females showing significantly lower levels of activity at ages 6 and 10 than the rest of the sample (Thomas & Richardson, 2005). Hypothesis 9 was proposed because changes in temperament may be related to pubertal maturation, specifically with regard to affect and activity levels (see review in Buchanan, Eccles, & Becker, 1992). Even though there were gender differences in activity scores and racial differences in activity and sociability scores in this sample, Hypotheses 7 and 8 may not have been confirmed in these analyses due to the fact that the relationship between activity or sociability and substance use was consistent among these groups. Even though African-Americans had significantly lower sociability scores than Caucasians, the African-Americans who did smoke had higher activity and sociability scores than the African-Americans who did not.

Hypothesis 10: The relationship between temperament and substance use will be mediated by problem behaviors at age 10, was also not confirmed, as none of the mediating relationships tested in these analyses was significant. This hypothesis was tested because temperament dimensions have been associated with behavior problems in childhood (Bates et al., 1985; Cameron, 1978; Caspi et al., 1995; Graham, Rutter, & George, 1973; McInerny & Chamberlin, 1978; Pettit & Bates, 1989; Prior et al., 1993; Thomas & Chess, 1977), and behavior problems, such as externalizing behaviors (King et al., 2004; Molina & Pelham, 2003),

aggression (Brook et al., 1989) and conduct disorder (Boyle et al., 1993), have been associated with substance use. This hypothesis may not have been confirmed because age 10 may be too early to investigate delinquent behavior. Also, at age 10, children were only asked whether or not they had participated in a specific type of delinquent behavior, as opposed to the number of times they had engaged in the behavior. Due to the distribution of the delinquency data, theft, status, and damage offenses were dichotomized. Children were categorized as participating in the behavior or not. A focus on a continuous measure of delinquency (e.g., number of times a specific type of offense was committed) may yield different results, as the extent of the involvement, as opposed to just participating or not, may be important. Alternatively, more age-appropriate indicators of externalizing behaviors, such as rule-breaking behavior in school or failure to comply with parental rules, may have been more successful mediators.

More recently, investigators have become interested in the shared and unique risk factors for initiation versus escalation or progression of substance use. Many studies have found that the initiation of alcohol, tobacco, marijuana, and stimulant use is strongly influenced by environmental risk factors, such as religiosity and sociodemographic variables (Heath & Martin, 1988; Heath & Martin, 1993; Heath et al., 1991; Heath et al., 1997; Kaprio et al., 1987; Kendler & Prescott, 1998; Kendler et al., 1999; Koopmans & Boomsma, 1996; Koopmans et al., 1999; Rose et al., 2001; Stallings et al., 1999). Risk factors for escalation are largely attributed to genetically heritable factors, such as history of conduct disorder, major depression, and personality variables (Heath et al., 1991; Hopfer et al., 2003; Koopsmans & Boomsma, 1996; Maes et al., 1999; Rose et al., 2001; Viken et al., 1999). The results from this project provide some support for these findings. Environmental variables were associated with initiation. Decreased maternal anxiety predicted alcohol initiation, while prenatal cigarette and marijuana

exposure predicted marijuana initiation. More biologically based variables were associated with escalation. Family history of major depression, in the form of maternal depression in this project, decreased IQ, and sociability predicted marijuana escalation.

Other interesting findings from this project include the fact that age 6 temperament measures were predictors of substance use at age 14, while temperament measures at age 10 were not. This may be a reflection of a state vs. trait issue. Perhaps at younger ages, these measures reflect maternal perceptions of their children's traits. As children age, and increase their ability to regulate their behavior, the measures may reflect the state of their children in social situations. In other words, when their children are younger, maternal reports of temperament may reflect their children's traits, or how they usually act. The EAS items mostly inquire about behaviors. At later ages, mothers may be inclined to base their answers on an average of how their children act in a variety of social situations, thereby combining the traits and states of their children to answer any particular question. This speculation may also explain why the correlations between age 6 and age 10 temperament constructs, which are thought to be relatively stable throughout the lifespan, were relatively low.

Alternatively, the inconsistency between age 6 and age 10 temperament measures as predictors of substance use may be related to maternal report bias. At age 6, maternal depression and anxiety were correlated with the emotionality subscale, but not the activity or sociability subscales. At age 10, the correlations increased in magnitude, and sociability was also correlated with maternal depression and anxiety. However, the main focus of this project was the early identification of risk factors for the early initiation of substance use. Increased activity and sociability levels at young ages can be used to help identify children who are at increased risk for smoking cigarettes by age 14. However, the failure of age 10 temperament measures to predict

substance use may simply be due to the fluctuations in findings that occur when associations between predictors and outcomes are not strong, as was the case in this project.

The relationship between temperament and substance use was not significant for dichotomous and categorical alcohol or marijuana outcomes. Many studies of adolescent substance use define substance use as a composite score consisting of use of tobacco, alcohol, marijuana, and occasionally, other drugs. These studies have found a relationship between temperament and substance use (Legrand, McGue, Iacono, 1999; Molina, Chassin, & Curran, 1994; Wills & Cleary, 1999; Wills, DuHamel, & Vaccaro, 1995). Others have examined individual substance use, and have also found relationships between lower social closeness and higher negative emotionality and alcoholism (Caspi et al., 1997), difficult temperament and tobacco, alcohol, and marijuana use (Lerner & Vicary, 1984), difficult temperament and tobacco, alcohol, and hard drug use (marijuana use was not significant; Windle, 1991), and increased activity levels and earlier initiation of marijuana use (Aytaclar et al., 1999). In this project, there may not have been enough use at age 14, or the cutpoints used in these analyses may not have been optimal for detecting a relationship between temperament and the use of individual substances. These choices of outcome measures could be considered a limitation to this project and will be discussed in the limitations section.

D. STUDY STRENGTHS

The strengths of this study lay in the timing of and methods used to collect data. The temperament data were collected with a widely used measure of childhood temperament, the EAS, which measures broad dimensions of temperament and is easily administered. Due to the

straightforward wording of the questions, the EAS was deemed appropriate for the lower education sample in the MHPCD Project. The temperament data were collected in early childhood, at a time when substance use is rare, so the directionality of the relationship could be assessed. The substance use data were collected in early adolescence, so they could be used to examine early onset. Also, the MHPCD Project measured the use of individual substances, which were analyzed both individually and collectively in a polysubstance use score. This project examined risk for each individual substance, and showed that there were similarities and differences in the risk factors associated with cigarette, alcohol, and tobacco use.

This sample is unique in that it is a birth cohort with detailed data on both children and mothers, including other predictors of substance use. The major strength of this study was the ability to examine childhood temperament as a predictor of early-adolescent substance use while considering other variables relevant to substance use risk. These data included prenatal substance exposure, family history of substance use problems, child IQ, child problem behavior, child psychiatric symptoms, pubertal status, parenting practices, maternal substance use, maternal psychiatric symptoms, quality of the home environment, race, gender, and family income.

This project adds to the existing literature of the effects of temperament on substance use by examining the direction of the relationship, which was not possible from cross-sectional data (Tarter et al., 1990; Wills et al., 1994, 1995, 1998; Windle, 1991). This project also examined temperament as a risk factor for substance use in early adolescence, as opposed to later adolescence and adulthood (Caspi et al., 1997; Krueger et al., 1996). Finally, this study adds to the temperament/substance use literature by examining the effects of temperament in the context

of other relevant variables, unlike some studies that did not control for covariates (Lerner & Vicary, 1984).

E. STUDY LIMITATIONS

There were several limitations of this project. One limitation was the reliance on maternal-rated temperament measures. Maternal reports of child temperament are not completely objective reports about their children. Parental reports can involve social perceptions that reflect objective child descriptions, as well as personality characteristics and mood of the parents (Bates, 1983). Others, however, have found that parents do not project their own personality onto the ratings of their children (Lyon & Plomin, 1981). The aggregation of maternal and paternal reports, or maternal and third party observer reports, would provide more reliable estimates of child temperament (Lyon & Plomin, 1981). However, the Maternal Health Practices and Child Development (MHPCD) project did not collect temperament measures from anyone other than the mother. Although there are some biases related to maternal reports of child temperament, these reports may still be considered useful for early identification and prevention. During infancy and childhood, parents are often best suited for this, since they presumably know their child better than anyone else, and observe their children in many situations and across long stretches of time.

A second limitation of this study lies in the generalizability of the results. This MHPCD Project cohort consisted of a low-income sample recruited to study prenatal drug use in pregnant women. The mothers' substance use, for the most part, was light to moderate, so the sample is not necessarily high-risk in terms of substance use. These were not addicted mothers. This

cohort is representative of an urban sample, and the results may be generalized to children growing up in an urban environment. Although this feature of the study may be viewed as a constraint on generalizability, it is also an important feature for understanding the developmental trajectory of children born into socioeconomically disadvantaged environments.

A third possible limitation of this study lies in the choice of measures. In addition to the temperament measure limitations discussed earlier, the pubertal status measure was a single item from the PDS asking children if they felt their development was much earlier, somewhat earlier, about the same, somewhat later, or much later than their peers. This single item may be subject to reporter bias. However, the total score from the PDS, indicating what stage of development the child was in at the time of the interview, was not appropriate for these analyses since children were interviewed at a range of ages. Age at first menstruation would have been a better measure of pubertal development for girls, but there is no equivalent measure for boys.

The choice of alcohol and marijuana outcomes may also have been a limitation of this project. The quantity by frequency substance use outcome measures were too skewed to use as continuous variables, even when transformed. Choosing the appropriate categorizations to measure frequency, or regularity, of use required much consideration.

Alcohol use was the most difficult substance to categorize and the literature provided a minimum amount of guidance. The alcohol literature mainly addresses problem drinking, which includes measures of consequences, which were not included in the MHPCD project data set. National surveys use a variety of definitions to measure alcohol use, but the quantity by frequency measurement did not seem to be appropriate for adolescents because of their use patterns, which consist mainly of binge drinking. In the end, regular use was defined as ≥ 1

drink / month, which matches the Youth Risk Behavior Surveillance System (YRBS) definition of current drinking.

The cutpoints for marijuana categorization were equally difficult to choose for different reasons. It is difficult to measure the quantity of marijuana consumed, due to the different potencies of marijuana available. It is difficult to measure quantity of marijuana consumed because marijuana is often shared, and it cannot be assumed that each individual consumes the same amount during the shared experience. Therefore, the frequency of consumption is often considered the more conservative estimate of choice. There is no consensus in the literature as to what regular marijuana use may be defined as at age 14, so the categorization of marijuana use was somewhat arbitrary. For consistency among outcome measures, the marijuana categorization was designed to match the alcohol categorization. These choices of categorization may have limited the ability of this project to detect the relationship between temperament and substance use.

F. IMPLICATIONS OF FINDINGS AND FUTURE DIRECTIONS

The public health implications suggested by this research, in combination with other longitudinal studies identifying early child personality and behavior variables that predict later substance use, are twofold. First, although prediction is modest, the findings suggest that children with certain temperamental characteristics may be identifiable as at-risk for cigarette use and/or initiation and the escalation of marijuana use. Temperament is, by definition, a fairly stable characteristic. However, this project has shown only moderate stability for temperament characteristics between ages 6 and 10, suggesting that there might exist some modifiability in

aspects of temperament that place children at risk. Second, the findings highlight the potential to implement prevention efforts at earlier ages. Due to the straightforward wording of the questions in the EAS, almost any parent can easily identify these broad dimensions of temperament at young ages. They may then prepare themselves to help prevent substance use as their children enter adolescence. These broad dimensions of temperament can also be easily identified by teachers, who could help identify children at increased risk for substance use, and either inform parents that their children are at risk, or recommend these children for extra prevention efforts supplied by the schools.

Two suggestions for prevention efforts that could be implemented by parents would include encouragement of participation in organized sports for highly active children, and encouragement of affiliation with non-deviant peers for highly social children. The Fast Track Program identified children with externalizing behaviors in early elementary school and implemented a prevention program aimed at reducing conduct problems in high-risk children, which has produced modest results (Bierman et al., 2004). The Fast Track results suggests that on-going work would be required to help modify these characteristics, as opposed to a one-time prevention program.

In the future, more work needs to be done to identify early childhood, as opposed to later childhood and adolescent characteristics, such as temperament and other psychological and behavioral characteristics that increase the risk for substance use, particularly early initiation. Many studies focus on characteristics in later childhood and adolescence that increase risk for substance use. With the identification of early childhood risk factors, children at increased risk for substance use can be identified at younger ages. This, in turn, can provide additional years in which prevention efforts can be implemented.

There also needs to be more work done to integrate the measurement of temperament across time. Various instruments exist for measuring temperament at specific ages. Some instruments, including the EAS (Buss & Plomin, 1984), which is used mainly in childhood, and the Revised Dimensions of Temperament Survey (DOTS-R, Windle & Lerner, 1986), which is used for adolescents, are based on Thomas and Chess' theory of temperament. Others, such as the Temperament and Character Inventory (TCI, Cloninger, Svarkic, & Przybeck, 1993; Svrakic et al., 1993), are based on Cloninger's theory of personality development (Cloninger, 1987). Even when instruments are based on the same theory of temperament, such as the EAS and DOTS-R, they do not necessarily measure the same constructs. The EAS measures emotionality, activity, sociability, and shyness. The DOTS-R measures activity level – general, activity level – sleep, approach/withdrawal, flexibility/rigidity, mood, rhythmicity – sleep, rhythmicity – eating, rhythmicity – daily habits, and task orientation. While there appears to be some overlap in some of the dimensions, such as activity and mood, these two instruments, both based on Thomas and Chess' theory of temperament development, do not measure the same constructs. Therefore, more work needs to be done in order to measure these constructs reliably and validly across different studies and across time.

G. CONCLUSIONS

This project has shown that increased levels of temperamental activity and sociability at age 6 significantly predicted substance use outcomes at age 14. These direct effects of activity and sociability remained when controlling for other predictors of substance use, including variables from environmental/demographic, child, and maternal domains. This project also

demonstrated the complexities involved in predicting substance use outcomes, in that variables from multiple domains each contributed to the prediction of substance use, and must be considered when examining the predictive value of individual variables. These results have great value for those interested in prevention and intervention efforts aimed at reducing substance use initiation and other outcomes. High activity and sociability levels in a child are easy to observe by parents and teachers. By understanding that these broad temperament characteristics, which can be identified as early as age 6, increase a child's risk for substance use, parents have several years in which to prepare themselves to help prevent these behaviors as their children reach adolescence.

APPENDIX A

EMOTIONALITY, ACTIVITY, SOCIABILITY, AND SHYNESS SURVEY

A.1 EMOTIONALITY, ACTIVITY, SOCIABILITY, & SHYNESS SURVEY

(BUSS & PLOMIN, 1984)

The score for each subscale is the average of the five items that make up each subscale. The scores are reversed for items 7, 8, 12, 16, 17, & 20.

1 = Never
2 = Rarely
3 = Sometimes
4 = Almost Always
5 = Always

Subscale Key	
E = Emotionality	A = Activity
S = Sociability	Shy = Shyness

Shy	1. Child tends to be shy.	1 2 3 4 5
E	2. Child cries easily.	1 2 3 4 5
S	3. Child likes to be with people.	1 2 3 4 5
A	4. Child is always on the go.	1 2 3 4 5
S	5. Child prefers playing with others rather than alone.	1 2 3 4 5
E	6. Child tends to be somewhat emotional.	1 2 3 4 5
A	7. When child moves about, he usually moves slowly.	1 2 3 4 5
Shy	8. Child makes friends easily.	1 2 3 4 5
A	9. Child is off and running as soon as he wakes up in the morning.	1 2 3 4 5
S	10. Child finds people more stimulating than anything else.	1 2 3 4 5
E	11. Child often fusses and cries.	1 2 3 4 5
Shy	12. Child is very sociable.	1 2 3 4 5
A	13. Child is very energetic.	1 2 3 4 5
Shy	14. Child takes a long time to warm up to strangers.	1 2 3 4 5
E	15. Child get upset easily.	1 2 3 4 5
S	16. Child is something of a loner.	1 2 3 4 5
A	17. Child prefers quiet, inactive games to more active ones.	1 2 3 4 5
S	18. When alone, child feels isolated.	1 2 3 4 5
E	19. Child reacts intensely when upset.	1 2 3 4 5
Shy	20. Child is very friendly with strangers.	1 2 3 4 5

APPENDIX B

TABLES

B.1 TABLES

Table 94. Child Domain Variables as Predictors of Cigarette Use Groups (Dichotomous Outcome)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Composite IQ	.666	.111	.703	.340
Depression	N/A	N/A	.032**	.027**
Anxiety	N/A	N/A	.064*	.023**
Depression/Anxiety	.119	.162	N/A	N/A
Externalizing Behavior	.002**	.003**	.003**	.005**
Pubertal Status	N/A	N/A	.503	.730
Aggression	.014**	.011**	.041**	.039**
Delinquency				
Status Offenses	N/A	N/A	.042**	.003**
Theft Offenses	N/A	N/A	.007**	.002**
Damage Offenses	N/A	N/A	.551	.188
Family History	N/A	N/A	.014**	.030**
Problems in Male in Household	.868	.886	.712	.744

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 95. Maternal Domain Variables as Predictors of Cigarette Use Groups (Dichotomous Outcome)

Variable	Prenatal		Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]	p-value	p-value [a]
Cigarette Use	.014**	.238	.001**	.019**	.000**	.008**
Alcohol Use	.592	.671	.337	.193	.754	.565
Marijuana Use	.867	.576	.716	.747	.665	.967
Cocaine Use	.819	.876	.606	.497	.771	.716
Other Drug Use	.403	.957	.927	.505	.652	.879
Depression	N/A	N/A	.040**	.031**	.023**	.038**
Anxiety	N/A	N/A	.059*	.072*	.484	.748
Physical Discipline	N/A	N/A	.519	.999	.386	.108

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 96. Environmental/Demographic Domain Variables as Predictors of Cigarette Use Groups (Dichotomous Outcome)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Quality of Home	.612	.032**	.385	.051*
Average Family Income	.519	.879	.412	.895
Race	.000**	.000**		
Gender	.032**	.035**		

[a] Controlling for race and gender

* $p < .10$

** $p \leq .05$

N/A = not assessed

Table 97. Child Domain Variables as Predictors of Cigarette Use Groups (Categorical Outcome)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Composite IQ	.952	.087*	.488	.207
Depression	N/A	N/A	.005**	.004**
Anxiety	N/A	N/A	.063*	.014**
Depression/Anxiety	.058*	.100	N/A	N/A
Externalizing Behavior	.005**	.012**	.003**	.007**
Pubertal Status	N/A	N/A	.367	.605
Aggression	.017**	.018**	.032**	.038**
Delinquency				
Status Offenses	N/A	N/A	.018**	.000**
Theft Offenses	N/A	N/A	.011**	.003**
Damage Offenses	N/A	N/A	.679	.179
Family History	N/A	N/A	.022**	.052*
Problems in Male in Household	.868	.886	.748	.740

[a] Controlling for race and gender

* $p < .10$

** $p \leq .05$

N/A = not assessed

Table 98. Maternal Domain Variables as Predictors of Cigarette Use Groups (Categorical Outcome)

Variable	Prenatal		Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]	p-value	p-value [a]
Cigarette Use	.002**	.244	.000**	.007**	.000**	.004**
Alcohol Use	.760	.631	.843	.692	.928	.693
Marijuana Use	.285	.887	.631	.704	.227	.439
Cocaine Use	.460	.769	.874	.713	.810	.732
Other Drug Use	.199	.836	.578	.800	.376	.615
Depression	N/A	N/A	.060*	.028**	.009**	.013**
Anxiety	N/A	N/A	.090*	.091*	.211	.412
Physical Discipline	N/A	N/A	.220	.667	.478	.096*

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 99. Environmental/Demographic Domain Variables as Predictors of Cigarette Use Groups (Categorical Outcome)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Quality of Home	.962	.022**	.684	.056*
Average Family Income	.850	.538	.454	.881
Race	.000**	.000**		
Gender	.003**	.003**		

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 100. Child Domain Variables as Predictors of Alcohol Use Groups (Dichotomous Outcome)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Composite IQ	.000**	.005**	.000**	.045**
Depression	N/A	N/A	.039**	.018**
Anxiety	N/A	N/A	.248	.049**
Depression/Anxiety	.450	.653	N/A	N/A
Externalizing Behavior	.027**	.040**	.004**	.009**
Pubertal Status	N/A	N/A	.226	.111
Aggression	.069*	.061*	.014**	.021**
Delinquency				
Status Offenses	N/A	N/A	.05**	.001**
Theft Offenses	N/A	N/A	.002**	.000**
Damage Offenses	N/A	N/A	.120	.010**
Family History	N/A	N/A	.585	.927
Problems in Male in Household	.967	.894	.291	.300

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 101. Maternal Domain Variables as Predictors of Alcohol Use Groups (Dichotomous Outcome)

Variable	Prenatal		Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]	p-value	p-value [a]
Cigarette Use	.003**	.239	.000**	.020**	.000**	.064*
Alcohol Use	.868	.750	.687	.784	.459	.835
Marijuana Use	.680	.545	.507	.645	.839	.698
Cocaine Use	.271	.566	.660	.525	.689	.560
Other Drug Use	.572	.660	.767	.521	.096	.207
Depression	N/A	N/A	.528	.608	.517	.754
Anxiety	N/A	N/A	.127	.079*	.579	.270
Physical Discipline	N/A	N/A	.806	.352	.864	.181

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 102. Environmental/Demographic Domain Variables as Predictors of Alcohol Use Groups (Dichotomous Outcome)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Quality of Home	.014**	.778	.072*	.799
Average Family Income	.238	.788	.095*	.565
Race	.000**	.000**		
Gender	.101	.110		

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 103. Child Domain Variables as Predictors of Alcohol Use Groups (Categorical Outcome)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Composite IQ	.000**	.021**	.001**	.115
Depression	N/A	N/A	.093*	.067*
Anxiety	N/A	N/A	.605	.267
Depression/Anxiety	.569	.733	N/A	N/A
Externalizing Behavior	.022**	.035**	.014**	.029**
Pubertal Status	N/A	N/A	.061*	.027**
Aggression	.035**	.027**	.029**	.034**
Delinquency				
Status Offenses	N/A	N/A	.020**	.000**
Theft Offenses	N/A	N/A	.001**	.000**
Damage Offenses	N/A	N/A	.204	.021**
Family History	N/A	N/A	.765	.950
Problems in Male in Household	.298	.338	.437	.432

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 104. Maternal Domain Variables as Predictors of Alcohol Use Groups (Categorical Outcome)

Variable	Prenatal		Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]	p-value	p-value [a]
Cigarette Use	.004**	.194	.001**	.071*	.002**	.168
Alcohol Use	.764	.723	.877	.605	.508	.876
Marijuana Use	.997	.347	.763	.937	.762	.356
Cocaine Use	.236	.438	.505	.395	.353	.292
Other Drug Use	.517	.797	.633	.760	.161	.301
Depression	N/A	N/A	.391	.425	.465	.603
Anxiety	N/A	N/A	.054*	.033**	.640	.345
Physical Discipline	N/A	N/A	.562	.721	.757	.204

[a] Controlling for race and gender

* $p < .10$

** $p \leq .05$

N/A = not assessed

Table 105. Environmental/Demographic Domain Variables as Predictors of Alcohol Use Groups (Categorical Outcomes)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Quality of Home	.014**	.487	.089*	.842
Average Family Income	.381	1.000	.125	.710
Race	.000**	.000**		
Gender	.035**	.032**		

[a] Controlling for race and gender

* $p < .10$

** $p \leq .05$

N/A = not assessed

Table 106. Child Domain Variables as Predictors of Marijuana Use Groups (Dichotomous Outcome)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Composite IQ	.975	.680	.818	.503
Depression	N/A	N/A	.059*	.059*
Anxiety	N/A	N/A	.341	.375
Depression/Anxiety	.596	.546	N/A	N/A
Externalizing Behavior	.004**	.004**	.004**	.003**
Pubertal Status	N/A	N/A	.262	.330
Aggression	.010**	.010**	.021**	.018**
Delinquency				
Status Offenses	N/A	N/A	.001**	.001**
Theft Offenses	N/A	N/A	.008**	.010**
Damage Offenses	N/A	N/A	.153	.213
Family History	N/A	N/A	.205	.181
Problems in Male in Household	.857	.767	.087*	.083*

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 107. Maternal Domain Variables as Predictors of Marijuana Use Groups (Categorical Outcome)

Variable	Prenatal		Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]	p-value	p-value [a]
Cigarette Use	.008**	.002**	.015**	.003**	.051*	.012**
Alcohol Use	.077*	.074*	.105	.134	.222	.245
Marijuana Use	.006**	.008**	.526	.556	.052*	.066*
Cocaine Use	.653	.692	.065*	.070*	.014**	.014**
Other Drug Use	.299	.227	.093*	.052*	.128	.104
Depression	N/A	N/A	.695	.718	.041**	.034**
Anxiety	N/A	N/A	.925	.894	.690	.604
Physical Discipline	N/A	N/A	.164	.241	.636	.784

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 108. Environmental/Demographic Domain Variables as Predictors of Marijuana Use Groups (Dichotomous Outcome)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Quality of Home	.001**	.001**	.001**	.001**
Average Family Income	.006**	.009**	.001**	.002**
Race	.511	.517		
Gender	.537	.544		

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 109. Child Domain Variables as Predictors of Marijuana Use Groups (Categorical Outcome)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Composite IQ	.894	.673	.818	.577
Depression	N/A	N/A	.027**	.031**
Anxiety	N/A	N/A	.609	.664
Depression/Anxiety	.349	.317	N/A	N/A
Externalizing Behavior	.001**	.000**	.001**	.001**
Pubertal Status	N/A	N/A	.335	.335
Aggression	.002**	.002**	.003**	.002**
Delinquency				
Status Offenses	N/A	N/A	.000**	.000**
Theft Offenses	N/A	N/A	.003**	.003**
Damage Offenses	N/A	N/A	.058*	.073*
Family History	N/A	N/A	.257	.236
Problems in Male in Household	.747	.838	.063*	.056*

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 110. Maternal Domain Variables as Predictors of Marijuana Use Groups (Categorical Outcome)

Variable	Prenatal		Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]	p-value	p-value [a]
Cigarette Use	.002**	.001**	.002**	.000**	.006**	.001**
Alcohol Use	.035**	.035**	.074*	.097*	.266	.296
Marijuana Use	.009**	.009**	.510	.566	.063*	.072*
Cocaine Use	.469	.480	.128	.130	.002**	.002**
Other Drug Use	.482	.457	.180	.120	.360	.321
Depression	N/A	N/A	.864	.900	.034**	.031**
Anxiety	N/A	N/A	.802	.813	.548	.508
Physical Discipline	N/A	N/A	.025**	.036**	.502	.549

[a] Controlling for race and gender

* $p < .10$

** $p \leq .05$

N/A = not assessed

Table 111. Environmental/Demographic Domain Variables as Predictors of Marijuana Use Groups (Categorical Outcome)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Quality of Home	.002**	.004**	.001**	.001**
Average Family Income	.008**	.011**	.001**	.001**
Race	.823	.823		
Gender	.947	.947		

[a] Controlling for race and gender

* $p < .10$

** $p \leq .05$

N/A = not assessed

Table 112. Child Domain Variables as Predictors of Polysubstance Use Groups (Categorical Outcome)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Composite IQ	.171	.592	.052*	.339
Depression	N/A	N/A	.039**	.028**
Anxiety	N/A	N/A	.128	.053*
Depression/Anxiety	.567	.754	N/A	N/A
Externalizing Behavior	.001**	.002**	.000*	.001**
Pubertal Status	N/A	N/A	.270	.179
Aggression	.009**	.009**	.010**	.017**
Delinquency				
Status Offenses	N/A	N/A	.001**	.000**
Theft Offenses	N/A	N/A	.000**	.000**
Damage Offenses	N/A	N/A	.107	.026**
Family History	N/A	N/A	.100	.182
Problems in Male in Household	.789	.803	.301	.295

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 113. Maternal Domain Variables as Predictors of Polysubstance Use Groups (Categorical Outcome)

Variable	Prenatal		Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]	p-value	p-value [a]
Cigarette Use	.001**	.020**	.000**	.001**	.000**	.001**
Alcohol Use	.376	.443	.223	.127	.465	.315
Marijuana Use	.181	.051*	.821	.869	.243	.148
Cocaine Use	.553	.796	.178	.152	.100	.097*
Other Drug Use	.517	.970	.421	.724	.123	.192
Depression	N/A	N/A	.501	.438	.112	.147
Anxiety	N/A	N/A	.989	.938	.687	.498
Physical Discipline	N/A	N/A	.509	.237	.460	.159

[a] Controlling for race and gender
* $p < .10$
** $p \leq .05$
N/A = not assessed

Table 114. Environmental/Demographic Domain Variables as Predictors of Polysubstance Use Groups (Categorical Outcome)

Variable	Age 6		Age 10	
	p-value	p-value [a]	p-value	p-value [a]
Quality of Home	.669	.093*	.337	.069*
Average Family Income	.857	.499	.914	.680
Race	.001**	.001**		
Gender	.340	.389		

[a] Controlling for race and gender

* $p < .10$

** $p \leq .05$

N/A = not assessed

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