DYADIC REGULATION AND DEVIANT CONTAGION IN ADOLESCENT FRIENDSHIPS: INTERACTION PATTERNS ASSOCIATED WITH PROBLEMATIC SUBSTANCE USE

by

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Peer influences on adolescence substance use have been widely demonstrated. In particular, social interactions that are centered around and reinforcing of antisocial values, known as *deviant peer contagion,* are predictive of a variety of antisocial outcomes, including substance use. However, much less is known about the interpersonal dynamics between friends that are associated with resilience to peer contagion. Recent work has associated self-regulation with resilience to the effects of associating with deviant and substance-using peers. Limited resource models of self-regulation have proposed that social interactions may tax regulatory resources to the point that self-regulation becomes impaired. Youth with more limited regulatory resources may demonstrate increased susceptibility to influence from peers. However, in friendship

interactions, self-regulatory behaviors are highly dependent on the self-regulation of the partner. Therefore, the present study examined *dyadic regulation* in friendship interactions consistent with the idea of a dyadic process. In addition to investigating the construct validity of dyadic regulation, it was hypothesized that dyadic regulation would moderate the impact of peer contagion on problematic substance use. Furthermore, consistent with a limited resource model, it was predicted that adolescents with declining dyadic regulation over the course of an interaction would be more susceptible to peer contagion.

Problematic substance use and interaction patterns within friendships were assessed in a sample of 711 (355 male, 356 female) ethnically diverse 16- and 17-year-old adolescents. Using videotaped observations of friendship interactions, dyadic regulation was assessed by rating responsiveness, self-focused intrusions, attention, and conversational turn-taking. Deviant peer contagion was assessed through the proportion of the interaction spent discussing deviant topics. Contrary to the hypothesized self-regulatory resilience model, those dyads that were more highly regulated while discussing deviant topics demonstrated the highest levels of problematic tobacco use. Consistent with a limited resource model of regulation, however, dyads with decreasing regulation over the course of an interaction appeared to be the most vulnerable to deviant peer contagion, demonstrating greater problematic marijuana use. These results are encouraging of further investigation in this area and may have implications for direct interventions targeting risk for substance use as well as reducing iatrogenic effects in group interventions.

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CHAPTER I

INTRODUCTION

Overview

Adolescence is a critical developmental period during which longitudinal trends of a variety of serious health-risking behaviors can be established. Substance use in particular is a risk factor for numerous health-related concerns, including adolescent suicide, particularly when comorbid with affective illness (Rowan, 2001); risky sexual behavior, including STD and HIV transmission (Howard & Wang, 2004); and future substance abuse disorders in adulthood (D'Amico, Ellickson, Collins, Martino, & Klein, 2005; Wills, Walker, & Resko, 2005). Furthermore, adolescent substance use is associated with delinquency, teenage pregnancy, and school misbehavior and drop out (Elliott, Huizinga, & Menard, 1989; Jessor & Jessor, 1977; Zabin, Hardy, Smith, & Hirsch, 1986). On a societal level, the consequences of adolescent substance abuse represent significant costs in health care, mental health services, drug and alcohol treatment, and juvenile crime (Hawkins, Catalano, & Miller, 1992).

Exposure to deviant peers (i.e., peers exhibiting substance use and other antisocial behaviors such as criminality and violence toward others) during adolescence has been widely demonstrated to play a powerful role in the onset of and growth in substance use and abuse (For a review, see Elliott, Huizinga, & Ageton, 1985). Specific mechanisms of deviant influence have been identified within adolescent friendship dyads that are predictive of longitudinal antisocial outcomes related to substance use (e.g., Dishion,

Spracklen, Andrews, & Patterson, 1996). Furthermore, these influence processes may promote iatrogenic intervention effects in aggregated youth (Dishion & Dodge, 2005). Although these influence effects have been well documented, far less is understood of the individual characteristics and interpersonal patterns that define resilience in these situations of influence. For example, many youth who are exposed to substance-using peers do not use themselves. This research sought to further understand the interpersonal dynamics of friendship interaction associated with resiliency to the influence of deviant peers on substance use outcomes.

Previous research investigating potential moderators of deviant peer influence within friendships has focused on both dyadic and individual level factors. At the individual level, recent work has identified self-regulation, or the general ability across situations to effectively maintain control over one's behavior, as an indicator of resiliency to some of the negative effects of association with deviant peers during adolescence (Gardner, Dishion & Connell, 2008; Piehler & Dishion, in preparation). Youth who are better able to manage their own behavior may be less susceptible to a peer's attempt at influence. At the dyadic level, closer, higher quality friendships as well as mutually engaged and reciprocal patterns of interaction may heighten influence processes between friends (Berndt, 2002; Dishion, Nelson, Winter, & Bullock, 2004; Piehler & Dishion, 2007). Deviant friendships that are particularly close, well organized and engaging may cause youth to more fully internalize a shared culture of deviance. The present study sought to combine these individual and dyadic approaches by examining the individual characteristic of self-regulation as it is reflected in a dyadic interaction process, in a

construct termed *dyadic regulation*. Because peer influence is inherently an interpersonal process, self-regulatory behaviors were examined from an interpersonal perspective to better understand their role in promoting risk or resilience. Furthermore, because of the interdependence of the behavior of dyadic members, the regulatory behaviors of both members of the dyad were assessed. Using videotaped observations of friendship interactions, the present study examined patterns of regulatory behaviors observed between friends and what role those dynamics played in moderating deviant peer influence.

Peer Influences on Substance Use

Negative peer dynamics have been consistently demonstrated to contribute to the amplification of child and adolescent problem behavior (Deater-Deckard, 2001; Dishion, Nelson, Winter, & Bullock, 2004; Elliott et al., 1985; Hawkins et al., 1992; Krohn & Thornberry, 1999; Snyder et al., 2005). Association with substance-using peer groups has been found to be the most robust predictor of substance use in adolescence (e.g., Elliott et al., 1985; Hawkins et al., 1992). Adolescents who associate with substance-using peers are both exposed to substance use and have increased opportunities for use (Hawkins et al., 1992). Furthermore, peer groups are likely to shape adolescents' attitudes about substance use, with those associated with substance-using peers more likely to have favorable attitudes about use (Hawkins et al., 1992).

An extensive program of research has consistently demonstrated that the dynamics of peer interactions assessed through observation are strongly predictive of a variety of antisocial outcomes, including substance use and abuse (Dishion et al., 1996; Dishion,

Eddy, Haas, Li, & Spracklen, 1997; Dishion et al., 2004; Dishion, Bullock, & Granic, 2002; Granic & Dishion, 2003; Patterson, Dishion, & Yoerger, 2000; Piehler & Dishion, 2007; Poulin, Dishion, & Haas, 1999). Using observational measures, Dishion et al. (1996) described an interactional process of peer influence previously known as *deviancy training* and more recently labeled *peer contagion* (Dishion & Dodge, 2005) that predicted escalations in several forms of adolescent problem behavior. Using sequential time series analyses, they found that the peer contagion process involves social reinforcement of deviant or "rule-breaking" discussion topics through laughter in dyadic conversation. When one member of a peer dyad discussed a deviant topic such as substance use or delinquent behaviors and the other member responded to that discussion with laughter, the first was more likely to continue discussing such deviant topics. Observed peer contagion has been associated with increased probability of substance use initiation and self-reported delinquency during a two-year period (Dishion et al., 1996; Dishion, Capaldi, Spracklen, & Li, 1995), increased violent behavior (Dishion, Eddy, Haas, Li, & Spracklen, 1997), and iatrogenic effects in group interventions (Dishion, Poulin, & Burraston, 2001). More recently, Granic & Dishion (2003) found that the simple duration of a deviant talk bout could be treated as an "attractor," and youth who were regularly "caught" in the deviant talk attractor tended to escalate in problem behavior from early to middle adolescence.

Moderating Dyadic Dynamics

While mechanisms of influence between peers have been clearly identified, relatively few specific moderating effects associated with either risk or resiliency have

been clearly identified. The few studies that have revealed dynamics of dyadic interaction involved in moderating peer influence processes have focused on characteristics that increase influence between friends. Piehler and Dishion (2007) investigated the interpersonal dynamics within friendships of youth associated with differing antisocial trajectories using the construct *dyadic mutuality*. Persistently antisocial adolescents were found to be less mutually responsive, engaged and reciprocal in their interactions when compared to adolescents with adolescent-onset or very little antisocial behavior. However, those youth who extensively discussed antisocial topics and were highly mutual in their interactions were found to demonstrate the highest levels of antisocial behavior. Those youth who appeared to be the most closely bonded over deviant values were at the greatest risk for problem behaviors. In an interesting parallel to the mutuality findings, Dishion and colleagues examined the dynamic systems indicator of *dyadic entropy*, or the level of predictability or organization in friendship interactions (Dishion, Nelson, et al., 2004). Friendship dyads with high levels of entropy, or chaotic, disorganized patterns of interaction, were found to be generally more antisocial than higher entropy dyads. However, those youth in dyads with a high level of deviant discussion content in their interactions and low levels of entropy were found to have escalated in their antisocial behavior at a follow-up assessment 10 years later. Thus, youth in friendships with highly organized interactions centered on deviant behavior corresponded with a heightened level of contagion. Less is known about how these dyadic processes may be related to individual characteristics of youth.

Self-regulation and Adolescent Substance Use

Self-regulation is thought to be an individual difference characteristic of adolescents that includes goal setting, planning, and task persistence, as well as the more immediate ability to execute inhibitory and effortful control (Dishion & Connell, 2006). It is hypothesized that by adolescence, individual differences are partially attributable to temperament (Rothbart, 2004; Wills & Dishion, 2004) but are also a developed set of skills learned in the context of family and school environments (Dishion & Patterson, 2006) and reinforced in friendships and later romantic relationships.

While self-regulation is a broad construct, the more specific construct of effortful control has been extensively studied as a key dynamic underlying self-regulation. Effortful control is conscious, voluntary regulation of attentional processes, goal-directed attentional persistence, and inhibitory control (Eisenberg, Fabes, Guthrie, & Reiser, 2000; Rothbart & Bates, 1998). Effortful control is associated with positive outcomes and adjustment (for a review, see Muris & Ollendick, 2005). Some studies have reported that higher levels of effortful control in childhood are associated with fewer conduct problems and better social adjustment (Eisenberg, Cumberland, et al., 2001; Eisenberg, Guthrie, et al., 2000; Eisenberg, Pidada, & Liew, 2001), as well as with resiliency in the presence of multiple risk factors (Eisenberg, et al., 2004).

Several studies link poor self-regulatory abilities (including those associated with effortful control) and substance use throughout development (e.g., Frick & Morris, 2004; Krueger, McGue, & Iacono, 2001). Children from ages 3 to 5 who demonstrated greater impulsivity, distractibility, and restlessness (Caspi, Moffitt, Newman, & Silva, 1996), as

well as general behavioral undercontrol and emotionality (Lerner & Vicary, 1984), were found to be more likely to be heavy substance users in adolescence. Among a group of 6th graders, ratings of inattention were found to be associated with early-onset smoking (Gardner, Dishion, & Posner, 2006). Dawes, Tarter, and Kirisci (1997) investigated the association between a construct they called behavioral self-regulation (BSR) and liability for substance use in preadolescent boys. Behavioral self-regulation consisted of surveyed information from multiple reporters about inattention, impulsivity/hyperactivity, and aggressivity. The sons of substance abusing fathers thought to be at high risk for future substance use demonstrated notably poorer BSR when compared to control youth. Interestingly, low BSR also predicted increased deviant peer association at a two-year follow-up, supporting its association with increased risk for substance use.

When assessed during adolescence, Elkins, King, McGue, and Iacono (2006) found that low behavioral constraint was strongly associated with adolescent substance use. In addition, behavioral undercontrol measured during adolescence predicted greater substance use (Stice, Kirz, & Borbely, 2002). Wills, Cleary, Filer, Shinar, Mariani, and Spera (2001) found a direct link between good self-control and decreased adolescent substance use when controlling for a variety of other environmental factors, including peer and parental substance use. Other theories of antisocial trajectories (Gottfredson & Hirschi, 1990; Moffitt, 1993; Wills, Cleary et al., 2001) have identified poor self-regulatory abilities, particularly self-control, as being central to persistent and early-onset antisocial behavior, criminality, and substance use.

Although poor self-regulatory abilities have been consistently associated with substance use, the precise mechanisms for these associations remain unclear. Recent work has proposed that superior self-regulatory ability may in part function to reduce risk for substance use and other problem behaviors by moderating the influence of deviant peer association (Gardner, Dishion, & Connell, 2008; Piehler & Dishion, in preparation; Wills, Sandy, Yaeger, & Shinar, 2001). Recent work by Dishion and colleagues that examined peer influences on antisocial behavior found that those adolescents identified by self-, parent, and teacher report to have higher levels of effortful control were found to be more resistant to associations with deviant peers (Dishion & Patterson, 2006; Gardner et al., 2008). Similar effects were found for substance use, with adolescents' effortful control moderating the relationship between substance-using peers and their future substance use (Piehler & Dishion, in preparation). Wills, Sandy et al. (2001) investigated positive emotionality and a temperament construct related to effortful control, *task attentional orientation* (the ability to focus attention on performing and completing tasks), for their potential to reduce family and peer risk factors for substance use. Using a combined "protective temperament" dimension employing these two constructs, they found that high levels of protective temperament traits were linked with a weaker association between both peer and parental substance use and adolescents' use of substances. Interestingly, no direct effect between protective temperament dimensions and substance use was found in their model.

Self-regulation in Interpersonal Situations

Self-regulation may play a significant role in interpersonal interactions relevant to peer influence. Wills and colleagues explain their findings by proposing that temperament variables do not have a direct relationship to problem behaviors, but rather affect patterns of relationships with others that may signify increasing risk for those behaviors (Wills, Cleary et al., 2001; Wills & Dishion, 2004; Wills, Sandy et al., 2001). These patterns of self-regulatory temperament traits as expressed in interactions with others may play a role in shaping the extent of peers' ability to resist influencing behavior. However, regulatory behaviors have not been examined in a peer interaction context or in conjunction with influence processes.

The ability to self-regulate in interpersonal situations has been suggested to be a critical aspect of self-regulation that may be linked to influence (Vohs & Ciarocco, 2004). Kathleen Vohs and colleagues detail a self-regulatory resource model in which the ability to maintain regulation is a limited-capacity resource that is taxed by environmental demands (Baumesister, Vohs, & Tice, 2007; Vohs, Baumeister, & Ciarocco, 2005; Vohs & Heatherton, 2000). When self-regulatory resources become overtaxed, the ability to effectively regulate behavior breaks down. In particular, difficult or unfamiliar interpersonal situations have been demonstrated to be particularly demanding of self-regulatory resources. Vohs, Baumeister & Ciarocco (2005) conducted a series of studies investigating the impact of efforts to maintain a desirable self-presentation in challenging interpersonal situations on self-regulatory resources. Participants completed such tasks as boastfully describing themselves to strangers, giving a speech emphasizing their positive

qualities, and giving opinions on race-related topics under the impression that they were the only representative of their race in the discussion. Following these tasks, self-regulatory ability was assessed through a variety of approaches, including persistence in tedious mathematical problems or unsolvable cognitive tasks, handgrip stamina, or emotion control. When compared to control individuals who had completed similar but less challenging interpersonal situations, performance on these self-regulatory tasks was significantly impaired. These results suggest that difficult interpersonal situations require self-regulation that may become subsequently depleted, resulting in a reduced ability to effectively regulate behavior.

A further set of studies by Vohs, Baumeister & Ciarocco (2005) examined self-presentation performance in interpersonal situations following standard tasks designed to deplete self-regulatory resources. After completing tasks requiring self-regulation such as thought or emotional suppression in a laboratory context, participants' self-presentations in interpersonal situations were evaluated. Participants who completed these tasks were found to be less effective in their self-presentation, by being overly loquacious, making overly or insufficiently intimate self-disclosures, or by being overly egotistical or arrogant. Thus, depletion of self-regulatory resources was associated with a reduced ability to effectively regulate behavior in an interpersonal setting.

The limited resource model appears to function in interpersonal situations in response to influence attempts. As increasing demands on self-regulation are made, the ability to resist pressure breaks down and influence is achieved. In one study investigating this theory, participants showed a greater resistance to political ideological

influence initially that tended to lessen over time (Knowles & Linn, 2004). This could likely function in situations of deviant peer influence as well, with adolescents' self-regulatory resources growing increasingly taxed in situations of peer influence until a breakdown of self-regulation occurs. For those adolescents with generally fewer self-regulatory resources, certain social and interpersonal contexts may overwhelm efforts to regulate one's own behavior and underlie negative peer influence.

While research on adolescent self-regulatory behaviors with peers is limited, there has been work in other dyadic interactions, including parent–child dyads (for a review, see McCabe, Rebello-Britto, Hernandez, & Brooks-Gunn, 2004) and couples (Wilson, Charker, Lizzio, Halford, & Kimlin, 2005). Brady-Smith, O'Brien, Berlin, Ware, & Fauth (1999) created a reliable observational rating system of sustained attention used in coding videotaped parent–child interactions (as described in McCabe et al., 2004). McCabe et al. (2004) also describe ecologically valid settings of assessment as being especially promising in the assessment of self-regulation, particularly when evaluating self-regulatory abilities such as sustained attention and inhibition. By examining the peer interaction context directly, this study aimed to extend previous research identifying individual self-regulation as an indicator of resiliency, to a more ecologically valid situation relevant to peer influence.

Dyadic Regulation

The present study will examine behavior in a dyadic interpersonal setting indicative of behavioral and attentional regulation, termed dyadic regulation. A variety of interpersonal behaviors have been identified as potentially important in observing

adolescent regulation in a dyadic setting. Swann & Rentfrow (2001) describe a construct called "blirtaciousness", which describes the extent to which individuals are unrestrained in their speaking style. Individuals high in blirtaciousness have difficulty inhibiting their tendency to verbalize their personal opinions and may even frequently interrupt others. Vohs et al. (2005) suggest that this construct is an indicator of self-regulation within an interaction, with more highly regulated individuals tending to be less blirtacious. Thus, the tendencies for adolescents to actively inhibit inappropriate self-directed comments and wait appropriately for their conversational turn (as opposed to talking over or interrupting their partner) was examined in the present study as indicative of higher dyadic regulation. Furthermore, Baumeister et al. (2007) note that fixing attention may be particularly taxing on self-regulatory resources. In an interpersonal context, maintaining an appropriate level of attention on a friend during an interaction would seem to be indicative of higher regulation, particularly when sustained over a substantial period of time. Finally, active participation in an interaction is described by Vohs et al. (2005) as a critical aspect of interpersonal impression management and associated with the utilization of self-regulatory resources. Therefore, the extent to which adolescents maintain active responding to the social cues of their interaction partner was also seen as indicative of dyadic regulation.

A major challenge of understanding the role of self-regulation in peer influence is how to best examine an individually-oriented construct within a dyadic process. It may be that individuals are relatively consistent in their ability to regulate themselves during interpersonal situations with little variability across dyadic partners. However, it seems

likely that individual regulation and the associated behaviors within a dyadic context are to some extent dependent on their partner's regulatory behavior and interpersonal style. Supporting this idea, Vohs et al. (2005) found that the extent to which self-regulatory resources are taxed is dependent on the demands of the interpersonal situation. Certain individuals are likely to elicit different self-regulatory behaviors within their dyadic partner. Furthermore, relationship-level characteristics are also likely to play a significant role in determining observed dyadic regulation. For example, it is easy to imagine youth who were particularly comfortable with each other exhibiting higher levels of regulation while interacting. Dyadic regulation may vary by the quality of the relationship, reflected by a higher quality interaction dynamic. A major goal of the present study was to examine the construct validity of dyadic regulation, by determining to what extent individual-level (e.g., self-regulation) or dyadic-level traits (e.g., relationship quality) are associated and relatedly, if dyadic regulation can be conceptualized as an individual characteristic or is better measured at the dyadic level.

Study Hypotheses

The current research investigated the role of dyadic regulation in promoting resiliency to deviant peer contagion, focusing on substance use outcomes. Because of the interest in health-risking behaviors, the current study focused on substance use outcomes indicative of problematic use including diagnoses of substance use disorders in addition to frequency of use. Furthermore, because individual substances (i.e., alcohol, tobacco, and marijuana) may have unique etiologies and risk factors during adolescence, models were examined separately for each substance. Dyadic regulation was assessed using two

approaches: a) mean levels over the course of an interaction with a peer, and b) consistent with the limited resource self-regulation model, the tendency to decrease in regulatory behaviors over the course of an interaction with a peer. Deviant peer contagion was evaluated through the extent that interaction content or conversational topics focused on deviant or antisocial acts. In addition to the major aim of examining the construct validity of dyadic regulation as described above, the following hypotheses were evaluated in the present study:

1) High levels of dyadic regulation will be directly associated with reduced risk for problematic substance use.

2) High levels of dyadic regulation will function as a moderator of observed deviant peer contagion, reducing the effects of deviant contagion on problematic substance use.

3) Dyads whose members demonstrate decreasing regulation over the course of an interaction will be more susceptible to deviant peer contagion, demonstrating more problematic substance use.

CHAPTER II

METHODS

Overview

Data from the proposed analyses are drawn from Project Alliance, a multiwave, longitudinal intervention study of 998 adolescents and their families in a large Pacific Northwest city. Project Alliance is designed to prevent early onset of adolescent problem behaviors by supporting middle school families living in high-risk neighborhoods (see Dishion & Kavanagh [2003] for a complete description). Approximately half of the adolescents and their families (n=500) were invited at the onset of the study to participate in a brief school-based, family-centered intervention targeting early-onset antisocial behavior and drug use. All 6th grade students from several targeted middle schools were approached for participation, and approximately 80% of participants were retained through the sixth wave of data collection. Below, the Project Alliance sample of participants is described, an explanation of measures is given, and analytic plans and procedures are outlined.

Sample

The full Project Alliance sample consists of multiple assessment waves of videotaped observations and survey instruments that were given to 998 adolescents, their families, and their teachers and that evaluated problem behaviors and a wide variety of other indices of socioemotional adjustment and functioning. Adolescents and their

teachers were primarily surveyed in their schools, and other family members were surveyed primarily though mailed questionnaires. Adolescents also completed additional videotaped observation tasks with an identified friend (i.e., Peer Interaction Task) at a research institute at Wave 6 (ages 16–17). At recruitment, the entire sample included 42.4% European American adolescents, 29.2% African American adolescents, 6.8% Hispanic adolescents, 6.1% Asian or Pacific Islander adolescents, 2.0% Native American adolescents, and 13.5% adolescents with multiple ethnic or racial backgrounds. Forty-seven percent of the adolescents were female, and 34.7% were from single-parent families. Gross annual household income was bimodal, with 12.8% of the families earning more than $90,000 annually and 12.2% of the families earning $30,000–$39,999 annually. The majority of primary caregivers either completed high school (22.8%) or had some college education (32.7%). The present study focused on the sixth wave of data collection when participants were in 11th grade and between 16 and 17 years old. Out of the entire sample, 711 participants brought in a friend to participate in the Peer Interaction Task at Wave 6. Because of the focus on peer interactions, data from only those 711 participants who completed the Peer Interaction Task were included in the present analyses. The demographic characteristics of participants retained through Wave 6 remained highly consistent with the sample at recruitment. Of the 711 adolescents, 355 were male and 356 were female.

Procedures and Measures

Peer Interaction Task. At Wave 6 (ages 16 and 17), study participants took part in a videotaped interaction task with a same-sex, self-nominated friend, which will be

analyzed in the current project. Adolescents were instructed to bring a close or "best" friend to the research office who was between 14 and 21 years old and had no familial relationship to the adolescent. The parents of the adolescent's friend were contacted to obtain informed consent if the friend was younger than 18. Each adolescent brought his or her friend (i.e., "peer") into the lab for a 45-minute, videotaped discussion covering a wide range of topics. Both the adolescent and the peer provided informed consent and completed a variety of measures about their perceptions of the friendship. The Peer Interaction Task (PIT) was designed to elicit a wide range of interactive behaviors within the dyad, and similar procedures were used in Piehler and Dishion (2007). Eight different topics were discussed for 5 minutes each, including (1) planning an activity together (something they could potentially do together in the next week), (2) a currently nominated problem of the adolescent, (3) a currently nominated problem of the peer, (4) drug and alcohol use, (5) goals for the next year, (6) friends and peer groups, (7) dating, and (8) planning a party. The first discussion, planning an activity, was considered a warm-up and was not included in coding and analyses. An interviewer entered the room to end each topic of discussion and to provide the next topic. Some adolescents brought in peers that were also participants in the Project Alliance study. Of the 711 dyads who participated in the PIT, 101 of them contained an adolescent who had also participated in another dyad. This practice was allowed in the interest of observing adolescents interact friends with whom they were the most comfortable and due to recruitment of students in the same or adjacent schools. See the results section below for further discussion of the issue of the non-independence of these dyads.

Self-reported substance use. At Wave 6, adolescents reported the total number of alcoholic beverages, cigarettes, and marijuana cigarettes they had consumed during the previous three months.

Substance use diagnoses. Adolescents participated in the computerized Composite International Diagnostic Interview (CIDI) core version 2.1 (Robins et al., 1989) at Wave 7, or ages 19-20. The CIDI is a widely used comprehensive diagnostic interview designed to be administered by trained lay administrators. Adolescents either completed the interview in person or over the telephone, with the administrator entering responses into the interview computer program in either administration format. The computerized version of the CIDI has demonstrated reliability and validity in assessing substance use diagnoses (Andrews & Peters, 1998; Ustun, et al., 1997). The DSM-IV diagnoses utilized from the CIDI in the present study included Nicotine Dependence, Nicotine Withdrawal, Alcohol Dependence, Alcohol Abuse, Cannabis Dependence, and Cannabis Abuse. Retrospective Wave 6 diagnoses (rather than diagnoses at the assessment point) were used in the present analyses, utilizing reports from adolescents of the duration and age of onset of their symptoms.

Adolescent- and peer-reported friendship characteristics. At the time of the Peer Interaction Task, both the adolescent and the peer individually completed instruments assessing a variety of characteristics of the friendship, including items that evaluate negative and positive friendship features. Positive friendship features were assessed using 3 items that evaluate various indicators of positive qualities within the friendship (i.e., "How happy are you with the friendship?" "How much would you like to have him or her

as a friend in the future?" "How often do you trust your friend with something important?"). Participants responded to the positive friendship feature items using 5-point scales, with the responses for the happiness item ranging from *Very Unhappy* to *Very Happy*, the friend in the future item ranging from *Not at All* to *Very Much*, and the trust item ranging from *Never* to *Very Often*. Negative friendship features were evaluated using 4 items that rate conflict and dissatisfaction within the friendship (e.g., "How often do you wish that you weren't friends? "How often do you get on each other's nerves?" "How often do you stop talking to each other because you are mad?"). Participants responded to the negative friendship feature items using a 5-point scale ranging from *Never* to *Very Often*. Both friendship scores demonstrated satisfactory standardized alpha reliabilities (positive friendship features: .64; negative friendship features: .78).

Observer-rated friendship quality. At the time of the Peer Interaction Task, the examiner rated the dyad on a variety of positive friendship qualities using a 5-point scale. The scale created consisted of 11 items total, focusing on either the adolescent and peer individually (e.g., seemed to genuinely like the other; seemed genuinely concerned about the other's problems) or the dyad (e.g., seemed to know each other well; how likely is it that the two will remain friends?; what was the level of humor or playfulness observed between the peers during the visit?). The scale demonstrated good internal inconsistency (standardized alpha reliability: .88).

Self-regulation. A subscale from the short form of the Early Adolescent Temperament Questionnaire–Revised (EATQ-R; Ellis & Rothbart, 2005) referred to as Effortful Control was used to indicate the self-regulation construct at Wave 6. The

EATQ-R produces 12 scales and has demonstrated adequate internal consistency and moderate convergence between adolescent and parent reports on each scale (Ellis, 2002). For these analyses, adolescent and parent reports on the three scales that constitute effortful control were used. For the parent reports, participants' mothers, fathers, and other guardians completed the Effortful Control scale. When multiple parent respondents were available, those responses were averaged into one parent-reported scale. Of the 684 participants whose parents provided reports, 2 participants had mother-, father-, and other guardian-reported data, 288 participants had mother- and father-reported data, 11 participants had mother- and other guardian-reported data, 340 participants had only mother-reported data, and 43 participants had only father-reported data

The three EATQ-R subscales used to create the self-regulation construct were Activation Control, Attention, and Inhibitory Control. Activation Control refers to "the capacity to perform an action when there is a strong tendency to avoid it"; Attention refers to "the capacity to focus attention as well as shift attention when desired"; Inhibitory Control is "the capacity to plan and to suppress inappropriate responses" (Ellis, 2002). Activation Control was measured using five items (e.g., "She/he has a hard time finishing things on time"; "I put off working on projects until right before they're due"), Attention was measured using six items (e.g., "It is easy for me to concentrate on homework problems"; "When trying to study, she/he has difficulty tuning out background noise and concentrating"; "I tend to get in the middle of one thing, and then go off and do something else"), and Inhibitory Control was measured using five items (e.g., "It's hard for me not to open presents before I'm supposed to"; "She/he has an easy

time keeping a secret"). The adolescent report and the parent report used essentially the same items with the pronouns changed appropriately. Adolescents and their parents responded to each item by using a 5-point Likert-type scale, rating how true each statement was for the adolescent. For both parent and adolescent report, the three subscales were combined to form self-regulation composite scores. This approach is consistent with other work that has used the EATQ-R–based self-regulation construct (Gardner et al., 2008). The adolescent-reported scale had a standardized item alpha of .63. The parent-reported scale had a standardized item alpha of .79.

In addition, teacher-reported temperament data were used to better corroborate parent- and self-reported data. Teachers responded to five items rating the frequency of each participant's behaviors on a 5-point Likert-type scale, including "thinks ahead of time about the consequences of actions," "plans ahead before acting," "pays attention to what he or she is doing," and "sticks to what he or she is doing until it is finished, even with unpleasant tasks." The teacher-reported scale had a standardized item alpha of .94.

Coding

General coding procedures. The videotapes were coded by 20 trained research assistants who were blind to information about the participants and experiment hypotheses. Coders used two different coding systems: the Topic Code Version 2.0 (Poe, Dishion, Griesler, Andrews, Piehler, & Peterson, 2006), which focuses on conversation content, and the Peer Interaction Task Coder Impressions Questionnaire (Dishion, Peterson, Piehler, Winter & Woodsworth, 2006), which covers coder ratings on a wide variety of interpersonal and individual dynamics within the dyad, including items

relevant to dyadic regulation. Coders used at least two passes to code each videotape, first using the microsocial Topic Code for the participant in the longitudinal study, and the second time using the Topic Code for the peer. All Topic Code coding occurred in "real time" with the Observer Pro, version 5.0 (2003), coding program run on a personal computer, which allowed for precise measurements of durations of each code. Coders were able to rewind and pause the videotapes in order to evaluate difficult sections. Coder Impression ratings were either specific to each 5 minute topic segment or general ratings covering the entire interaction. Depending upon the focus of the Coder Impression ratings, the ratings were given either after viewing each 5-minute segment or after viewing both passes of the entire tape. Thus, each member of the dyad received 7 sets of segment specific ratings, one from each segment, as well as ratings that were general for the entire interaction. Approximately 15% of the data (108 tapes) were randomly sampled and coded by two separate coders in order to assess reliability.

Deviant peer contagion. Deviant peer contagion in the Peer Interaction Task was assessed through the implementation of the Topic Code. The Topic Code utilizes a form of discourse analysis that focuses on all incidences of talk and behavior that contain any symbolic or overt content (See Dishion et al. [1996] for more information) and categorizes all discussion and gestures by each member of the dyad into one of two topics: deviant or normative. The code is microsocial and identifies precise durations of each specific code using the Observer Pro coding software. Deviant topics represented any content that violated societal norms, and normative content was all content that did not fit into the deviant category. The deviant category included all verbal and nonverbal

behavior that was not appropriate to the setting or task, or that violated community or societal rules. Examples are all illegal activities, including using drugs and alcohol or causing purposeful physical or emotional harm to someone else (e.g., "Weed is always a good time"). This category also included topics that are inappropriate to this particular setting (e.g., crude gestures or songs, talking about or doing gross activities) but do not refer to illegal activities.

Although in past work the analysis of peer contagion included contingent laughter, Dishion and colleagues found that by far the most frequent dyadic response to deviant talk was reciprocity in deviant talk. Previous research on the analysis of deviant talk revealed that duration of a deviant talk episode provided a normally distributed index for the deviancy training process (Dishion, 2000; Granic & Dishion, 2003, Piehler & Dishion, 2007). Therefore, a percent duration score was used, which simply refers to the percentage of the total time a dyad engaged in deviant talk. Percent durations of each code were computed within each task for each member of the dyad. These durations were then combined and averaged for overall percent duration scores across the interaction. A larger percentage of the interaction devoted to discussing deviant topics indicated more extensive deviant peer contagion with the dyad. Coders maintained adequate reliability using the Topic Code ($\kappa = .79$; 82% agreement), allowing for the same code to occur within a 6-second margin of error. With this approach, the coding software used did not allow for individual reliabilities to be computed for each code, thus reliability information is for all Topic Code codes, including those focusing on conversational topic as well as other structure codes not analyzed in the present study (e.g., pauses, assenting).

Dyadic regulation. Dyadic regulation was assessed using multiple items from the Coder Impressions rating system. Both the adolescent and the peer were individually rated on all items. Items were either segment-level (given for each 5-minute segment of the interaction) or general (representing the entire interaction). The coding system relied on global ratings of regulatory behaviors in several domains, including one general item assessing attention control (i.e., does the adolescent maintain attention focused onto their dyadic partner?), one segment-level item assessing activation control (i.e., does the adolescent actively participate and respond to their partner during the interaction?), and two items, one segment-level and one general, assessing inhibitory control/impulsivity (i.e., segment-level: does the adolescent demonstrate excessive self-focused intrusions?; general: does the adolescent allow conversational turn taking without excessive interruptions?). Ratings for all items were given on a 9-point Likert scale (e.g., 1 = *rarely or never,* 5 = *a moderate amount,* 9 = *always or throughout*). See Appendix 1 for the full dyadic regulation rating items. The self-focused intrusion item was reverse scored so that like the other items, a higher score indicated more regulatory behaviors. For the dyadic regulation items on the Coder Impressions, coders maintained 80% agreement allowing for 2-point discrepancies between ratings on tapes coded twice for reliability.

Two different types of dyadic regulation scores were created for each member of the dyad, a single overall score for the entire interaction and 7 segment-level scores representing each 5-minute segment of the interaction. For the overall dyadic regulation score, the two segment-level items were averaged across segments to form general ratings for the entire interaction. These two items were then averaged with the two

general items to form the overall dyadic regulation score consisting of four items. This overall score had a standardized alpha reliability of .79 for the adolescent, .79 for the peer, and .85 for the dyadic level score, using 8 items from both the adolescent and the peer. Segment-level dyadic regulation scores were also computed for each individual and for the dyad as a whole. Individual segment-level scores were created by averaging the two segment-level items. Dyadic level segment scores were created by averaging the four segment-level items (2 adolescent items and 2 peer items). The alpha reliabilities of these dyadic segment-level scores ranged from .54 (segment 3) to .71 (segments 4 and 8).

Analysis Strategy

Structural equation and latent growth models were estimated using the structural equation modeling program Mplus version 4.1 (Muthén & Muthén, 2006). Outcomes related to each substance (i.e., tobacco, alcohol, and marijuana) were analyzed separately. Some missing values were present in the dataset, but adequate covariance coverage was present (a minimum of .91 across models). Missing data in all models were estimated using a maximum-likelihood estimation procedure used by Mplus version 4.1 (Allison, 2003). As is common with substance use data, the substance use variables demonstrated a significant amount of positive skew. To correct for this skew, a logarithmic transformation was used on all frequency of use substance use variables. Categorical diagnostic data obtained from the CIDI was not transformed. Latent Wave 6 substance use status outcomes were estimated using three indicators, including 1) a frequency of use measure, 2) a categorical variable indicating of presence or absence of a DSM-IV diagnosis of Dependence for the specific substance, and 3) a second categorical variable

indicating presence or absence of a DSM-IV diagnosis of Abuse in the cases of marijuana and alcohol, and Nicotine Withdrawal in the case of tobacco. All models were cross-sectional in nature, utilizing only Wave 6 relevant data.

Several models that were estimated involved interactions between continuous latent variables and continuous observed variables. The Mplus program uses a latent moderated structural (LMS) equation algorithm for computing interaction terms, as described by Klein and Moosbrugger (2000). This approach uses a full information maximum-likelihood procedure and is appropriate for modeling interactions between a continuous latent variable and a continuous observed variable (Muthén & Muthén, 2006). As described in Klein and Stoolmiller (2003), the LMS approach has been found to yield efficient parameter estimates and a reliable model difference test, and does not appear to demonstrate a bias of standard errors (Klein & Moosbrugger, 2000; Schermelleh-Engel, Klein, & Moosbrugger, 1998). For more information about using a maximum-likelihood estimation procedure to model interactions involving latent variables, see Muthén and Asparouhov (2003). Furthermore, a Monte Carlo integration algorithm was used to estimate the interaction models (Muthén & Muthén, 2006). All variables (latent or observed) were centered around their means when used in creating interaction terms, with the exception of the latent slope factor involved in the interaction growth models (see Hypothesis 3 below). When estimating interaction models, the version of Mplus used in these analyses does not compute standardized estimates of model parameters or the most commonly used fit statistics (i.e., chi-square, CFI, RMSEA). Therefore, unstandardized

parameter estimates and Bayesian and loglikelihood values are provided for most models for purposes of comparison.

CHAPTER III

RESULTS

Descriptive Statistics

Table 1 displays the means and standard deviations of each of the primary variables used in the present study. Table 2 displays the percentages and number of adolescents from among the entire present sample who reported any use of tobacco, alcohol, or marijuana in the preceding three months at the Wave 6 assessment. Furthermore, the percentages and number of substance use diagnoses at Wave 6 are noted. The prevalence of use reported within the sample is generally consistent with prevalences reported for a similar developmental period in national epidemiological studies of adolescent substance use (National Institute on Drug Abuse, 2006).

Table 1. Means and standard deviations of study variables.

Variable	Mean	Standard Deviation
Adolescent Regulation Score	1.62	1.20
Peer Regulation Score	1.77	1.17
Dyadic Regulation Segment 2	1.50	1.08
Dyadic Regulation Segment 3	1.41	1.04
Dyadic Regulation Segment 4	1.59	1.17
Dyadic Regulation Segment 5	1.43	1.14
Dyadic Regulation Segment 6	1.46	1.18

Table 1 Continued.

Variable	Mean	Standard Deviation
Dyadic Regulation Segment 7	1.50	1.15
Dyadic Regulation Segment 8	1.64	1.13
Dyadic Deviant Talk Percent Duration	7.33	9.38
Frequency of Tobacco Use (Untransformed)	63.71	277.22
Frequency of Marijuana Use (Untransformed)	23.69	194.41
Frequency of Alcohol Use (Untransformed)	13.53	59.70
Parent-reported Self-regulation	3.34	0.53
Adolescent-reported Self-regulation	3.34	0.48
Teacher-reported Self-regulation	2.92	0.90
Observer-rated Friendship Quality	4.21	0.58
Dyad Positive Friendship Qualities	4.02	0.45
Dyad Negative Friendship Qualities	1.79	0.51

Table 2. By substance, percentages and number of participants reporting use in the past three months or meeting criteria for related DSM-IV diagnoses.

	% Of Sample (No. of Users or Diagnosed/Total No. of Respondents)		
	Tobacco	Alcohol	Marijuana
Use in the last 3 months	22.9% (163/711)	41.1% (292/711)	26.9% (191/711)
DSM-IV Dependence	3.0% (20/657)	3.3% (25/657)	6.1% (40/657)
DSM-IV Abuse	*	15.4% (101/657)	15.1% (99/655)
DSM-IV Withdrawal	3.3% (22/657)	*	*

Note. *No DSM-IV diagnosis of this type exists for this substance.

Repeat PIT Participants

Out of the full sample of 711 dyads, 101 of those dyads contained one adolescent completing their second Peer Interaction Task. While the focus of these analyses was at the dyadic level, it could be argued that these dyads are not fully independent of other dyads due to a shared member. After performing a series of t-tests examining differences in key variables for those dyads containing a "repeat" member, it was revealed that those youth who participated in a second PIT were systematically different on several key variables than youth who had only completed a single PIT. Primarily, these youth demonstrated significantly higher levels of substance use and substance use diagnoses. The reason for these differences is not fully clear. Because of these systematic differences, it was decided not to exclude those dyads containing a repeat participant due to the potential of further biasing of the sample.

Construct Validity

Several approaches were used to determine the validity of the dyadic regulation construct. Initial efforts were focused on determining whether individual- or dyad-based scores were most appropriate for conceptualization and subsequent analyses. See Table 3 for correlations between the adolescent and peer's scores. For these correlations, the segment-level items were averaged across segments to form mean scores for the entire interaction. Correlations between individual items composing the adolescent's regulation scores ranged in magnitude from moderate ($r = -.35$, $p < .001$; adolescent responsiveness and adolescent self-focused intrusions) to strong ($r = .60$, $p < .001$; adolescent attention control and adolescent turn-taking) and the peer's also ranged from moderate ($r = -.33$, $p < .001$; peer responsiveness and peer self-focused intrusions) to strong ($r = -.60$, $p < .001$; peer turn taking and peer self-focused intrusions) for the peer. The adolescent and the peer's overall regulation scores were strongly correlated ($r = .56$, $p < .001$). Corresponding items for the adolescent and the peer ranged from very strongly correlated ($r = .83$, $p < .001$; responsiveness) to moderately correlated ($r = .36$, $p < .001$; turn taking).

Table 3. Correlations between overall scores and individual regulation items for the adolescent and the peer.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Adolescent Regulation Score	—	.65	−.79	.88	.81	**.56**	.54	−.38	.53	.32
2. Adolescent Responsiveness		—	−.35	.47	.37	.51	**.83**	−.27	.33	.30
3. Adolescent Intrusions			—	−.58	−.57	−.33	−.25	**.43**	−.30	−.08*
4. Adolescent Attention Control				—	.60	.56	.40	−.35	**.68**	.27
5. Adolescent Turn Taking					—	.36	.32	−.15	.31	**.36**
6. Peer Regulation Score						—	.66	−.79	.86	.82
7. Peer Responsiveness							—	−.33	.47	.41
8. Peer Intrusions								—	−.57	−.60
9. Peer Attention Control									—	.56
10. Peer Turn Taking										—

Note. Corresponding items for the Adolescent and Peer are in **bold**
All correlations are significant at $p < .001$, unless noted. $^{*}p < .05$

As is described above, a number of the study adolescents (n=101) also participated as "peers" in other adolescents' Peer Interaction Tasks in addition to their own PIT. Table 4 presents correlations between the first and second PIT trials in order to compare regulation scores from one session to the next. In the third row and column of Table 4, "PIT #2 Adolescent Regulation Score" indicates the adolescent's score from the

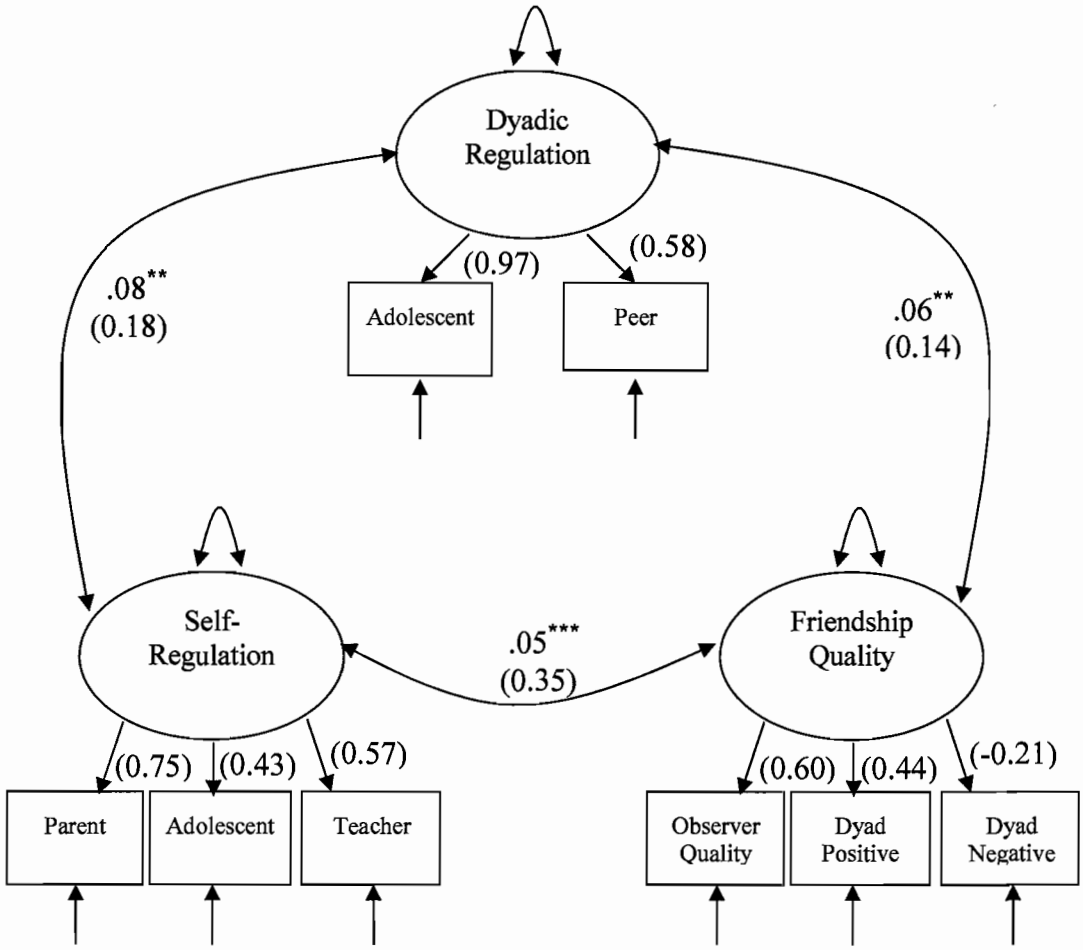
second PIT trial that the adolescent participated in as the peer. In the fourth row and column, "PIT #2 Peer Regulation Score" indicates the regulation score of that adolescent's peer (also a study adolescent) from the second PIT trial. Those adolescents that completed two PITS showed only moderate regulation score correlations across trials (r =.25, p < .001). The regulation scores of adolescents' peers across trials (different individuals) were not reliably associated (r =.18, p =.07). Based on 1) the relatively high correlation of regulation scores within a dyad compared to scores of the same individual across trials (with a different partner) and 2) the strong correlations between some of the corresponding items for the adolescent and the peer (within the same dyad), it was apparent that the regulation scores were better conceptualized as a dyadic construct, that is, a function of the friendship more than the individual. In subsequent analyses, a dyadic level regulation score was utilized by combining the scores of the adolescent and the peer.

Table 4. Correlations between regulation scores of first and second Peer Interaction Tasks.

	1.	2.	3.	4.
1. Adolescent Regulation Score	—	.56***	.25*	.08
2. Peer Regulation Score		—	.24*	.18
2. PIT #2 Adolescent Regulation Score			—	.52***
4. PIT #2 Peer Regulation Score				—

Note. ***p < .001 **p < .01 *p < .05

Adolescent's dyadic regulation scores were compared to related constructs, including individual effortful control (the study adolescent only) and friendship quality variables. A confirmatory factor analysis is presented in Figure 1 depicting the relationship between the three constructs, using a latent dyadic regulation construct with regulation scores from both the adolescent and the peer as indicators, along with a latent effortful control construct based on adolescent, parent, and teacher report, and a latent friendship quality construct indicated by an observer friendship quality score, and dyadic-reported scores of positive and negative friendship features. Correlations for the CFA variables are reported in Table 5, and covariances and variances are reported in Table 6. The model was an adequate fit for the data, $\chi^2(17) = 67.14$, $p = .000$, CFI = .92, RMSEA = .064. The dyadic regulation construct demonstrated low to moderate associations with both the self-regulation construct ($r = .18$, $p < .01$), and the friendship quality construct ($r = .14$, $p < .01$). Interestingly, friendship quality and self-regulation were more moderately associated ($r = .35$, $p < .001$).



Model Fit:
N=711
$\chi^2(17)=67.14$, $p=.000$; CFI=.916
RMSEA=0.064

*$p<.05$ **$p<.01$ ***$p<.001$
Note: Unstandardized values are reported. (Standardized values are reported in parentheses)

Figure 1. A confirmatory factor analysis examining dyadic regulation, self-regulation, and friendship quality.

Table 5. Correlations between dyadic regulation, self-regulation, and friendship quality variables.

	1.	2.	3.	4.	5.	6.	7.	8.
1. Adolescent Regulation Score	—	.56***	.14***	−.03	.17***	.10*	.00	−.13**
2. Peer Regulation Score		—	.05	−.06	.10*	.12**	.03	−.15***
3. Parent-reported Self-regulation			—	.35***	.42***	.11**	.08*	−.15***
4. Adolescent-reported Self-regulation				—	.21***	.01	.05	−.14***
5. Teacher-rated Self-regulation					—	.18***	.09*	−.15***
6. Observer Friendship Qual.						—	.29***	−.09*
7. Dyad Positive Friendship Qual.							—	−.06
8. Dyad Negative Friendship Qual.								—

Note. *** $p < .001$ ** $p < .01$ * $p < .05$

Table 6. Covariances and variances of dyadic regulation, self-regulation, and friendship quality variables.

	1.	2.	3.	4.	5.	6.	7.	8.
1. Adolescent Regulation Score	1.43†	.78***	.08***	−.02	.18***	.07*	.00	−.08**
2. Peer Regulation Score		1.37†	.03	−.03	.10*	.08**	.01	−.09***
3. Parent-reported Self-regulation			.28†	.09***	.20***	.03**	.02*	−.04***
4. Adolescent-reported Self-regulation				.23†	.09***	.00	.01	−.04***
5. Teacher-rated Self-regulation					.80†	.09***	.03*	−.07***
6. Observer Friendship Quality						.33†	.07***	−.03*
7. Dyad Positive Friendship Qualities							.20†	−.02
8. Dyad Negative Friendship Qualities								.26†

Note. ***$p < .001$ **$p < .01$ *$p < .05$ †Variance

The CFA was examined for potential gender, ethnicity, or intervention differences by estimating two-group models. A two-group model by gender was estimated, with a Chi-squared difference test revealing a superior fit for the original single group model (χ^2 Diff(27) = 47.32, p<.01). Additional two-group models was estimated for European American versus African American participants (χ^2 Diff(27) = 23.10, p=.68), and for the

intervention versus control groups, (χ^2 Diff(27) = 17.37, p=.92), with Chi-squared difference tests revealing non-significant differences in fit from the single group model.

Hypothesis 1

In order to examine the direct relationship between dyadic regulation and substance use, a series of path models were estimated examining the direct effects of deviant talk and dyadic regulation on substance use outcomes for tobacco, alcohol, and marijuana. Correlations for each of these models are reported in Table 7, and covariances and variances are reported in Table 8. The direct effects model of tobacco use status is shown in Figure 2 (loglikelihood = −6257.13; adjusted BIC = 12575.31). The model revealed that deviant talk was a reliable predictor of tobacco use status (b = .03, *SE* = .01; $p < .001$), but dyadic regulation did not explain a significant amount of variance. Deviant talk and the latent dyadic regulation construct demonstrated a significant negative covariation (cov= −2.93; $p < .001$), meaning that better regulated dyads were likely to demonstrate less deviant talk. Equivalent alcohol and marijuana use models were also estimated, revealing that while deviant talk continued to be strongly predictive across all models ($p < .001$), dyadic regulation was not directly predictive of problematic substance use. Thus, the overall models were not supportive of the direct effects hypothesis.

Table 7. Correlations between tobacco, marijuana, and alcohol interaction path model variables.

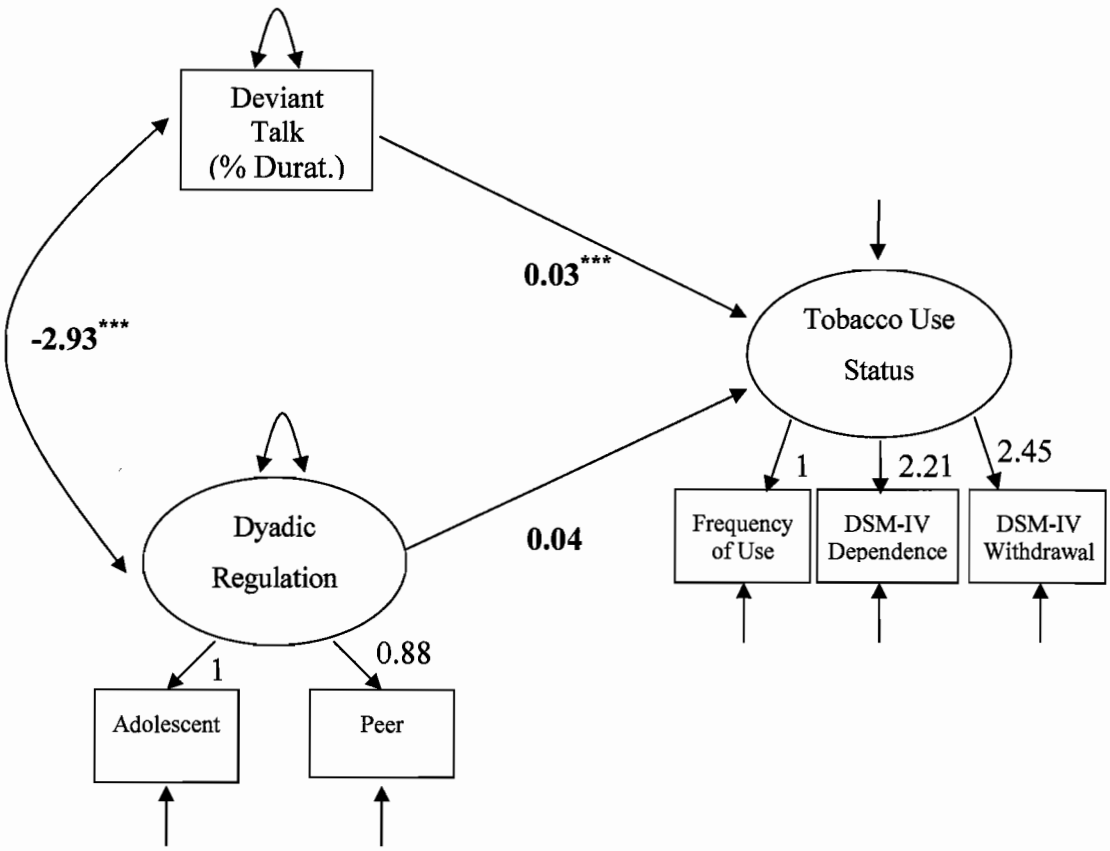
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Adolescent Regulation Score	—	.56***	−.27***	−.08*	.00	.03	−.18***	−.04	−.05	−.08*	−.11**	−.02
2. Peer Regulation Score		—	−.24***	.03	.01	.03	−.04	−.01	−.02	−.04	−.07	−.01
3. Dyadic Deviant Talk Percent Duration			—	.19***	.04	.04	.28***	.22***	.13**	.25***	.26***	.12**
4. Frequency of Tobacco Use				—	.40***	.37***	.42***	.28***	.14***	.41***	.26***	.16***
5. DSM-IV Nicotine Withdrawal (Binary)					—	.41***	.19***	.14***	.09*	.20***	.11**	.05
6. DSM-IV Nicotine Dependence (Binary)						—	.19***	.20***	.14***	.17***	.12**	.06
7. Frequency of Marijuana Use							—	.47***	.33***	.58***	.41***	.21***
8. DSM-IV Cannabis Abuse (Binary)								—	.36***	.38***	.49***	.25***
9. DSM-IV Cannabis Dependence (Binary)									—	.28***	.30***	.25***
10. Frequency of Alcohol Use										—	.37***	.24***
11. DSM-IV Alcohol Abuse (Binary)											—	.36***
12. DSM-IV Nicotine Dependence (Binary)												—

Note. $^{***}p < .001$ $^{**}p < .01$ $^{*}p < .05$

Table 8. Covariances and variances of tobacco, marijuana, and alcohol interaction path model variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Adolescent Regulation Score	1.43†	.78***	−3.02***	−.17*	.00	.01	−.31***	−.02	−.01	−.14*	−.05**	.00
2. Peer Regulation Score		1.37†	−2.60***	.06	.00	.01	−.06	−.01	−.01	−.08	−.03	.00
3. Dyadic Deviant Talk Percent Duration			87.93†	3.41***	.07	.07	3.79***	.72***	.28**	3.50***	.85***	.20**
4. Frequency of Tobacco Use (Log)				3.62†	.13***	.11***	1.14***	.18***	.06***	1.16***	.17***	.05***
5. DSM-IV Nicotine Withdrawal (Binary)					——††	.01***	.05***	.01***	.00*	.05***	.01**	.00
6. DSM-IV Nicotine Dependence (Binary)						——††	.04***	.01***	.01***	.04***	.01**	.00
7. Frequency of Marijuana Use (Log)							2.08†	.24***	.11***	1.24***	.21***	.06***
8. DSM-IV Cannabis Abuse (Binary)								——††	.03***	.20***	.06***	.02***
9. DSM-IV Cannabis Dependence (Binary)									——††	.10***	.03***	.01***
10. Frequency of Alcohol Use (Log)										2.23†	.20***	.07***
11. DSM-IV Alcohol Abuse (Binary)											——††	.03***
12. DSM-IV Nicotine Dependence (Binary)												——††

Note. ***$p < .001$ **$p < .01$ *$p < .05$ †Variance ††No variance is provided because this is a binary variable



Model Fit:
Free Parameters: 18
Loglikelihood = -6257.13
Adj. BIC = 12575.31

N=711

*p<.05 **p<.01 ***p<.001
Note: Unstandardized values are reported.

Figure 2. A path model of the effects of the percentage duration of deviant talk and dyadic regulation on tobacco use status.

Hypothesis 2

Interaction path models were then estimated in order to test for a moderating effect of dyadic regulation on deviant talk in predicting substance use outcomes. Interaction models were estimated by adding an interaction term between deviant talk and dyadic regulation to the direct effect models. The tobacco use interaction model (See

Figure 3; loglikelihood = −3684.59; adjusted BIC = 7423.56) revealed that the interaction term aided significantly in predicting tobacco use status, (b = .02, *SE* = .01; $p < .05$). See Figure 4 for a graphical illustration of the interaction term. The figure reveals that, contrary to the hypothesized direction, those dyads that were well regulated and demonstrated more extensive deviant talk were associated with the greatest tobacco use. Equivalent interaction models for alcohol and marijuana use were also estimated, but none revealed significant interaction terms in predicting substance use status. Percentage duration of deviant talk continued to be a significant predictor of substance use status for both models ($p < .001$).

The preceding path models were examined for differences related to gender or ethnicity. Due to use of categorical indicators to the latent outcome variable, Mplus utilized numerical integration and is unable to compute multiple group analyses. While a comprehensive test of differences by gender or ethnicity is not possible, two alternative approaches were utilized. First, gender and ethnicity were included as covariates in the model to examine any potential differences in the main effects of the model. In both the direct effects model (Figure 2) and the interaction model (Figure 3), the inclusion of these covariates produced no notable changes in the magnitude or direction of any other effects. Second, single group models were estimated containing only participants from single subgroups (e.g., only male participants) and compared to single group models containing only that groups counterpart (e.g., only female participants). The parameters of models including only male participants (n =355) and only female participants (n=356) were generally consistent for both the direct effects and interaction models. For African

American (n= 214) participants and European American (n= 320) participants, no notable differences in the model parameters were present in either the main effect or interaction models. The intervention group (n=344) versus the control group (n=367) also revealed no notable differences in model parameters.

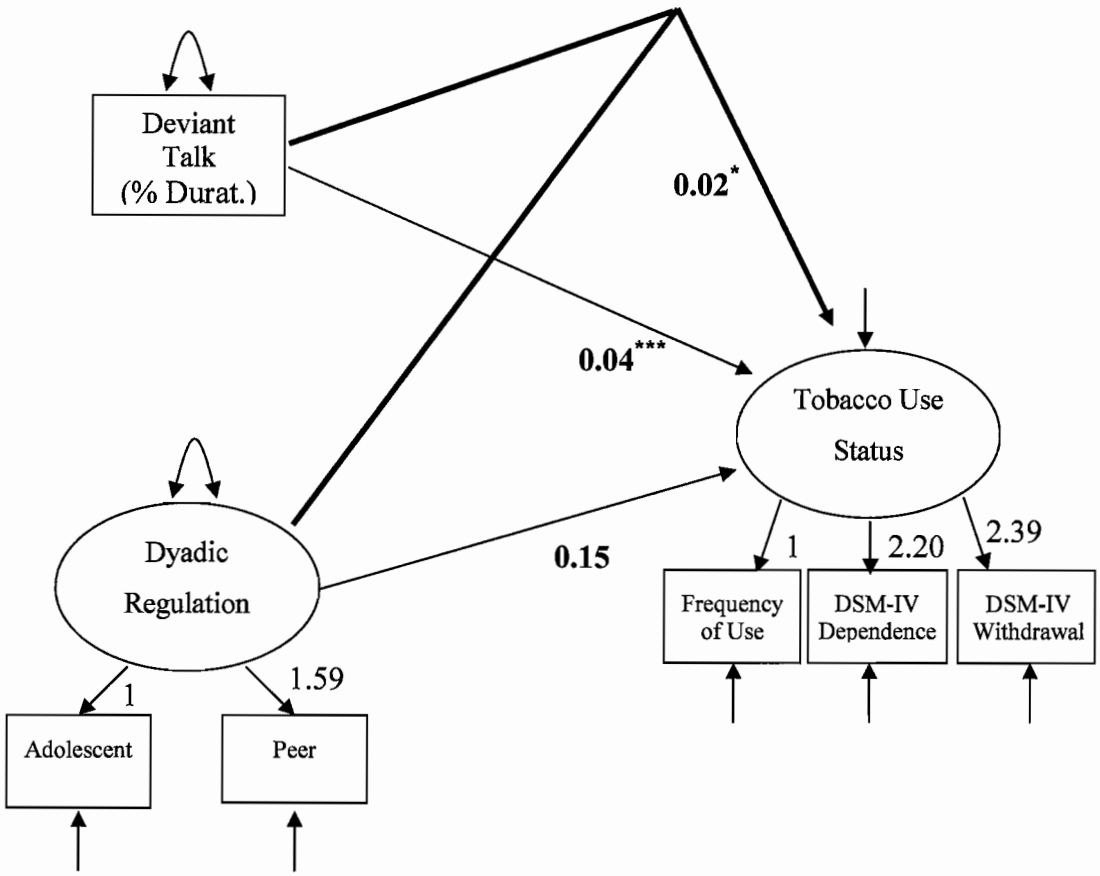


Figure 3. An interaction path model of the effects of the percentage duration of deviant talk and dyadic regulation on tobacco use status.

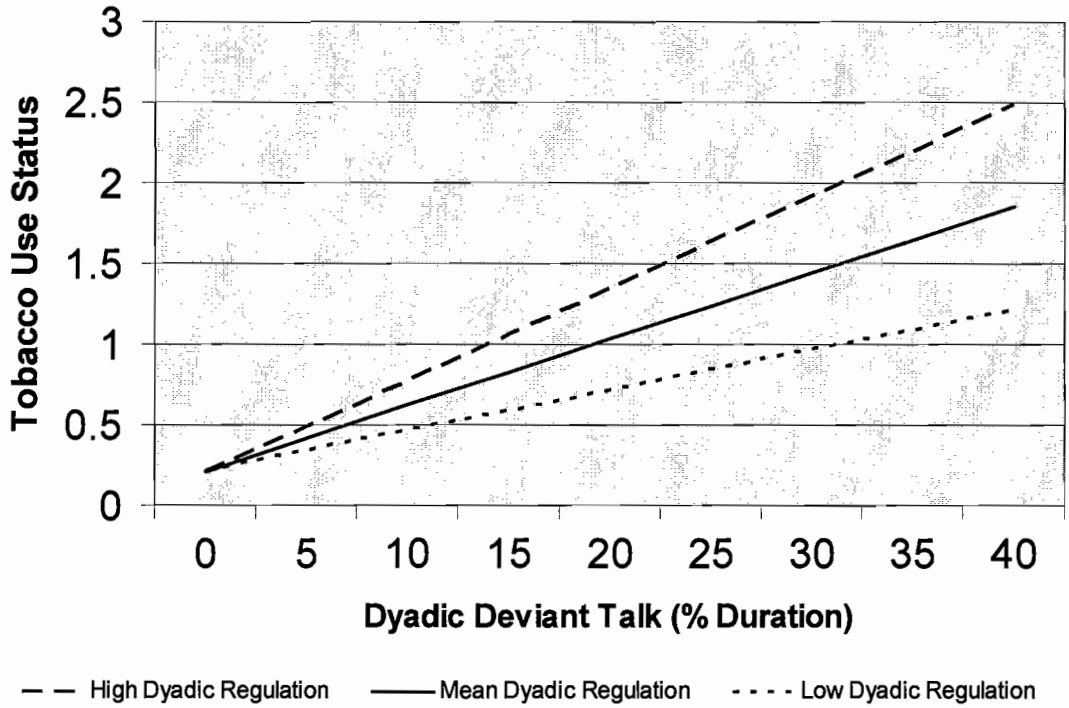


Figure 4. The interaction between percentage duration of deviant talk and dyadic regulation in predicting tobacco use status.

Hypothesis 3

In order to examine the limited resource model of regulation, a series of latent growth models examining segment-level dyadic regulation scores were estimated. In order to create segment-level dyadic regulation scores, the two-item segment-level regulation scores for the adolescent and the peer were averaged to form a single segment-level dyadic regulation score consisting of four items total (two items from the adolescent and two corresponding items from the peer). These models estimated latent intercept and slope factors representing the initial level of dyadic regulation in the interaction and the overall growth trend over the course of the interaction, respectively. Figure 5 depicts the basic latent growth model of dyadic regulation over the final seven tasks of the PIT. As

stated above, the first task was considered a warm-up and was not coded or included in any analyses. The model was an adequate fit for the data, $\chi^2(23) = 154.21$, $p = .000$, CFI = .96, RMSEA = .090, loglikelihood = −5865.58; adjusted BIC = 11771.85. The model revealed a reliable positive linear trend of the slope factor (M= .02, *SE*= .01; $p < .001$), indicating that dyads tended to increase their regulation over the course of the interaction. The model slope and intercepts were negatively correlated ($r = -.15$; $p < .001$), demonstrating that dyads with higher initial regulation tended to show less positive growth in regulation over the course of the interaction.

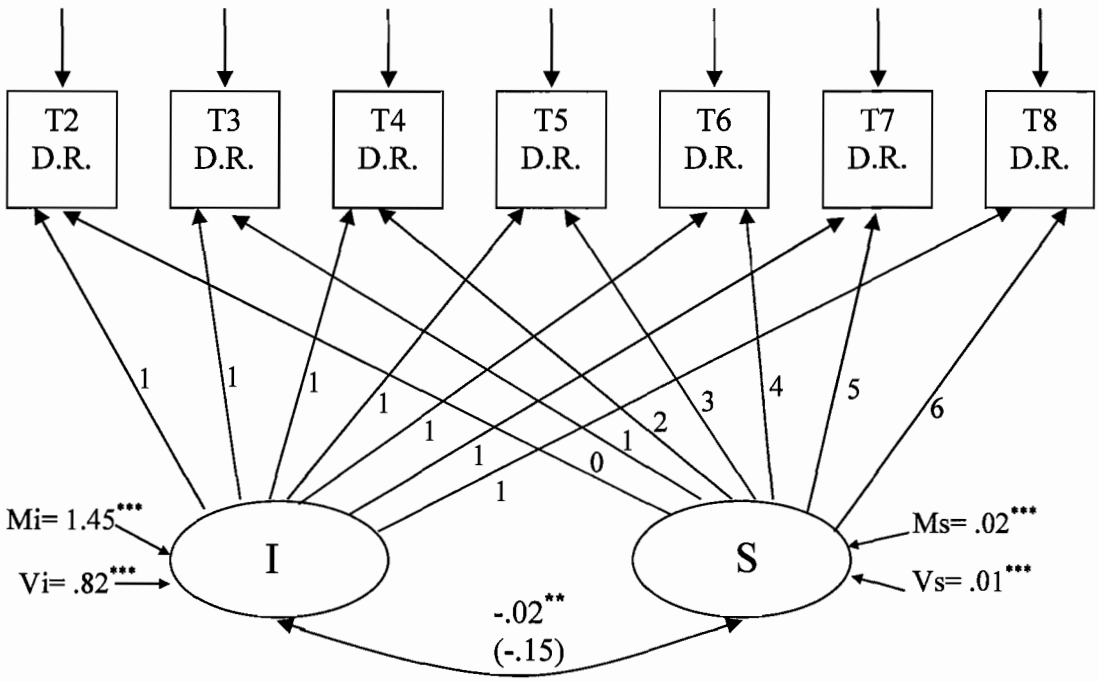


Figure 5. A latent growth model of dyadic regulation by task.

In order to investigate any differences in the growth model by gender, ethnicity, or intervention status, multiple two-group models were estimated. All two-group models did not result in a significant improvement in fit over the original single group model (Gender: χ^2 Diff(23) = 28.26, p=.21; African American versus European American: χ^2 Diff(23) = 5.42, p=.99; Intervention: χ^2 Diff(23) =24.20, p=.39), therefore the single group model was accepted as the final model.

A measurement model for the latent growth factors was estimated in order to examine the association between the latent slope and intercept factors and self-regulation and friendship quality. See Table 9 for model correlations and Table 10 for variances and covariances. Figure 6 depicts the measurement model, which was an acceptable fit for the data ($\chi^2(69) = 243.15, p = .000$, CFI = .957, RMSEA = .060, loglikelihood = −9082.19; adjusted BIC = 18175.07). The model revealed that the model intercept was positively associated with the latent friendship quality construct (r= .23; $p < .001$), but was not reliably associated with self-regulation. The model slope demonstrated a trend-level positive association with self-regulation (r= .11; p =.09), but was not associated with friendship quality. This measurement LGM was examined for potential differences by gender, ethnicity, and intervention status by estimating two-group models. None of the two-group models revealed an improvement in fit over the single group model (Gender: χ^2 Diff(77) = 110.11, p<.01; African American versus European American: χ^2 Diff(77) =77.47, p=.46; Intervention: χ^2 Diff(77) =57.41, p=.95).

Table 9. Correlations between latent growth measurement model variables.

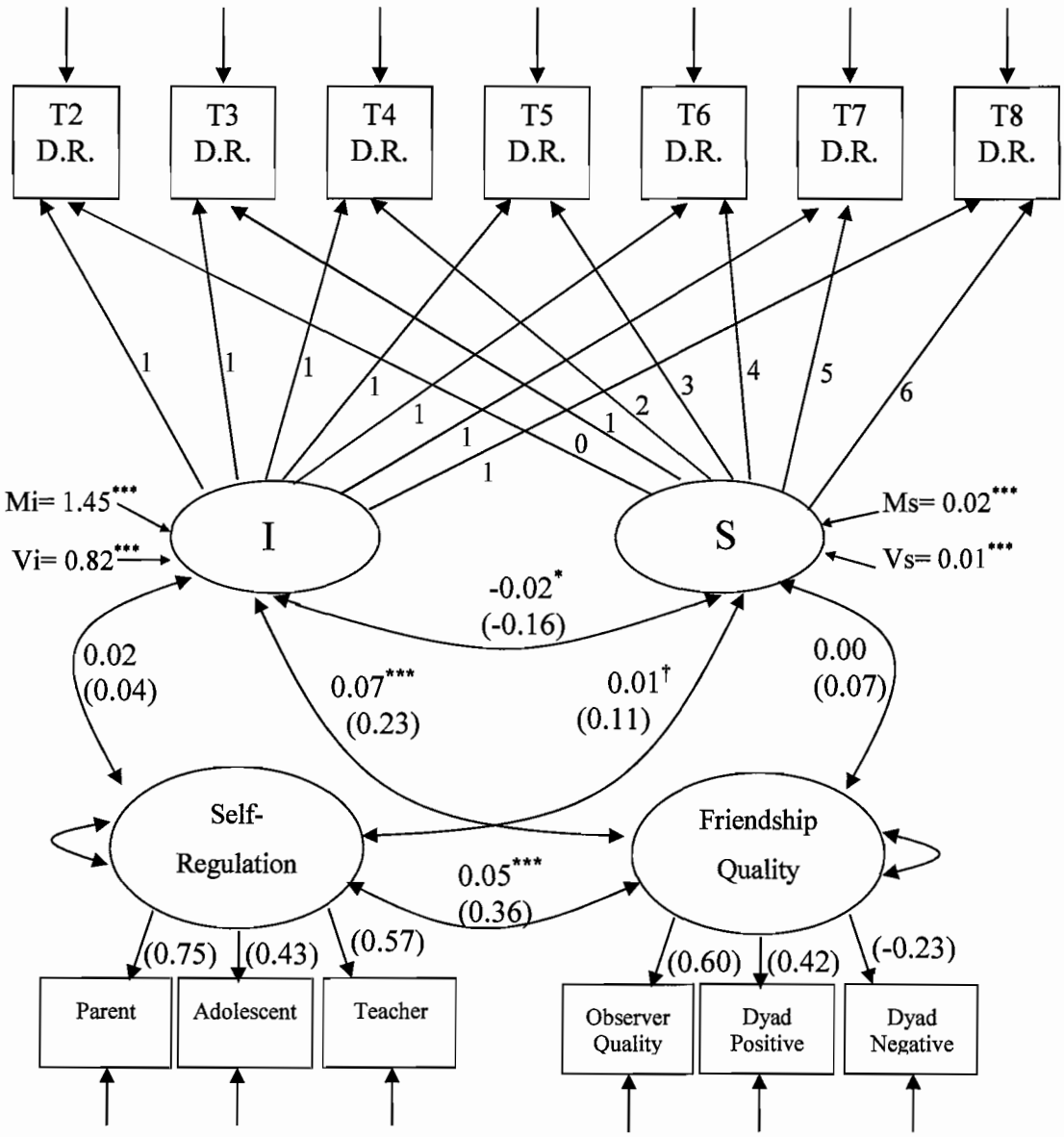
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Dyadic Regulation Segment 2	—	.72***	.63***	.61***	.59***	.59***	.58***	.04	−.08*	.05	.14***	−.01	−.10**
2. Dyadic Regulation Segment 3		—	.67***	.63***	.60***	.60***	.61***	.04	−.06	.08	.16***	.02	−.10*
3. Dyadic Regulation Segment 4			—	.69***	.68***	.65***	.67***	.08	−.05	.09*	.16***	.02	−.14***
4. Dyadic Regulation Segment 5				—	.73***	.68***	.67***	.03	−.10**	.08*	.11***	.02	−.13***
5. Dyadic Regulation Segment 6					—	.76***	.74***	.07	−.03	.14***	.13***	.03	−.14***
6. Dyadic Regulation Segment 7						—	.75***	.08	−.04	.10*	.14***	.03	−.13**
7. Dyadic Regulation Segment 8							—	.07	−.09*	.16***	.14***	.03	−.11**
8. Parent-reported Self-regulation								—	.35***	.42***	.11**	.03	−.15***
9. Adolescent-reported Self-regulation									—	.21***	.01	.04	−.14***
10. Teacher-reported Self-regulation										—	.18***	.09*	−.15***
11. Observer-rated Friendship Quality											—	.29***	−.09*
12. Dyad Positive Friendship Qualities												—	−.06
13. Dyad Negative Friendship Qualities													—

Note. $^{***}p < .001$ $^{**}p < .01$ $^{*}p < .05$

Table 10. Covariations and variances of latent growth measurement model variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Dyadic Regulation Segment 2	1.16†	.80***	.79***	.74***	.75***	.73***	.71***	.02	−.04*	.05	.09***	−.01	−.05**
2. Dyadic Regulation Segment 3		1.08†	.81***	.75***	.73***	.72***	.72***	.02	−.03	.07	.09***	.01	−.05*
3. Dyadic Regulation Segment 4			1.36†	.92***	.93***	.88***	.88***	.05	−.03	.10*	.10***	.01	−.08***
4. Dyadic Regulation Segment 5				1.30†	.97***	.89***	.86***	.02	−.06**	.08*	.07***	.01	−.08***
5. Dyadic Regulation Segment 6					1.39†	1.03***	.99***	.04	−.02	.15***	.09***	.02	−.09***
6. Dyadic Regulation Segment 7						1.32†	.98***	.05	−.02	.11*	.09***	.02	−.08**
7. Dyadic Regulation Segment 8							1.28†	.04	−.05*	.16***	.09***	.02	−.07**
8. Parent-reported Self-regulation								.28†	.09***	.20***	.03**	.02	−.04***
9. Adolescent-reported Self-regulation									.23†	.09***	.00	.01	−.04***
10. Teacher-reported Self-regulation										.80†	.09***	.03*	−.07***
11. Observer-rated Friendship Quality											.33†	.07***	−.03*
12. Dyad Positive Friendship Qualities												.20†	−.02
13. Dyad Negative Friendship Qualities													.26†

Note. ***$p < .001$ **$p < .01$ *$p < .05$ †Variance



Model Fit: N=711
$\chi^2(69)=243.15$, $p=.000$; CFI=.957
RMSEA=0.060
Loglikelihood = -9082.19
Adj. BIC = 18175.07

*$p<.05$ **$p<.01$ ***$p<.001$ † $p=.09$
Note: Unstandardized values are reported (Standardized values are reported in parentheses)

Figure 6. A latent growth measurement model of dyadic regulation by task, friendship quality, and self-regulation.

Latent growth models predicting substance use status outcomes were estimated next. In order to compare these models with the subsequent interaction models, the latent intercept factor was centered around its mean by fixing the intercepts of the dyadic regulation segment-level scores to be equivalent and fixing the mean of the intercept factor at zero (Muthén & Asparouhov, 2003). Figure 6 depicts an LGM model with the slope and intercept factors predicting marijuana status outcome, loglikelihood = −7457.29; adjusted BIC = 14985.80. The model revealed that the slope of dyadic regulation was negatively associated with marijuana use status, (b = −1.38, *SE* = .53; $p <$ .01). Supporting the limited-resource model, dyads that demonstrated reduced growth (or a reduction) in regulation over the course of the interaction were more likely to be heavier marijuana users. The intercept factor was not a reliable predictor of marijuana use status. The corresponding tobacco use model (loglikelihood = −7441.23; adjusted BIC = 14953.68) revealed that dyadic regulation slope was a marginally significant negative predictor of tobacco use status (b = −1.41, *SE* = .81; p = .08). The model intercept was again not a reliable predictor of tobacco use status. The alcohol use model (loglikelihood = −7469.18; adjusted BIC = 15009.58) revealed that neither the slope nor intercept factors were significant predictors of alcohol use status.

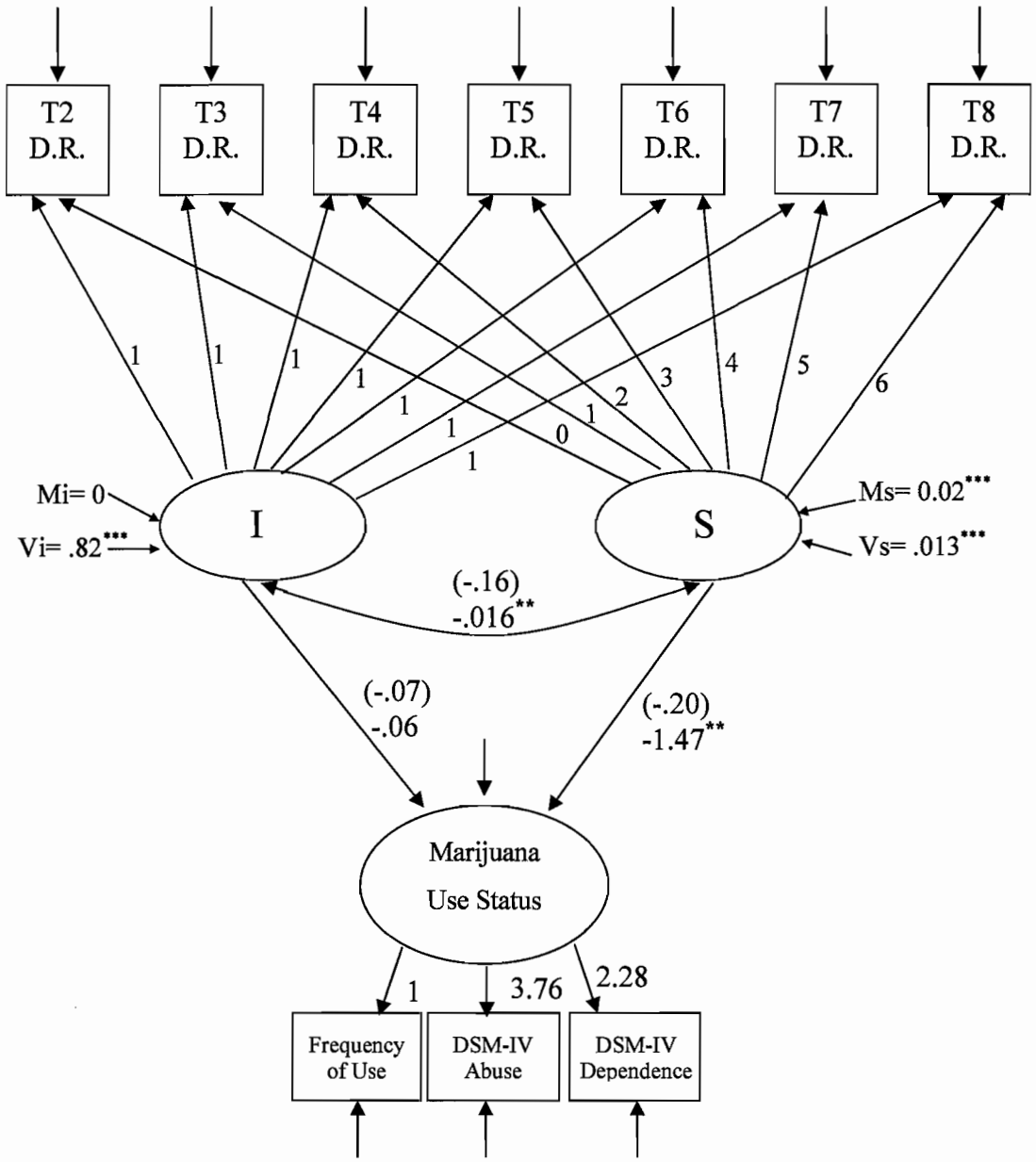


Figure 7. A latent growth model of dyadic regulation by task predicting marijuana use status.

Interaction latent growth models were estimated that included the percentage duration of deviant talk as a covariate as well as two deviant talk interaction terms with the slope and intercept factors. The model intercept was centered around its mean as described above. In creating an interaction term with the latent slope factor, the slope was not centered around its mean because this would inappropriately constrain growth within the model, but the interaction term remains interpretable (B. Muthén, personal communication, April 17, 2008). Correlations for the marijuana use model are reported in Table 11, and covariances and variances are reported in Table 12. Figure 7 depicts the marijuana use status interaction LGM model (loglikelihood = −7463.64; adjusted BIC = 15008.67). Deviant talk continued to be positively associated with marijuana use status (b = .05, *SE* = .01; $p < .001$). The model slope also continued to demonstrate a negative association with marijuana use, (b = −3.30, *SE* = .58; $p < .001$), but the intercept did not add significantly to the prediction of use. Both the interaction term between deviant talk and the slope (b = −.44, *SE* = .08; $p < .001$) and the interaction term between deviant talk and the intercept (b = −.01, *SE* = .004; $p < .05$) contributed significantly to predicting marijuana use.

Table 11. Correlations between marijuana use interaction latent growth model variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Dyadic Deviant Talk Percent Duration	—	−.15***	−.12**	−.20***	−.24***	−.22***	−.24***	−.22***	.28***	.22***	.13**
2. Dyadic Regulation Segment 2		—	.72***	.63***	.61***	.59***	.59***	.58***	−.09*	.00	.03
3. Dyadic Regulation Segment 3			—	.67***	.63***	.60***	.60***	.61***	−.06	.04	.01
4. Dyadic Regulation Segment 4				—	.69***	.68***	.65***	.67***	−.11**	−.02	.01
5. Dyadic Regulation Segment 5					—	.73***	.68***	.67***	−.10**	−.01	.02
6. Dyadic Regulation Segment 6						—	.76***	.74***	−.10**	−.02	−.05
7. Dyadic Regulation Segment 7							—	.75***	−.13**	−.03	−.05
8. Dyadic Regulation Segment 8								—	−.14***	−.05	−.02
9. Frequency of Marijuana Use									—	.47***	.33***
10. DSM-IV Cannabis Abuse (Binary)										—	.36***
11. DSM-IV Cannabis Dependence (Binary)											—

Note. ***$p < .001$ **$p < .01$ *$p < .05$

Table 12. Covariances and variances of marijuana use interaction latent growth model variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Dyadic Deviant Talk Percent Duration	87.93†	−1.47***	−1.16**	−2.14***	−2.54***	−2.46***	−2.57***	−2.34***	3.79***	.72***	.28**
2. Dyadic Regulation Segment 2		1.16†	.80***	.79***	.74***	.75***	.73***	.71***	−.14*	.00	.01
3. Dyadic Regulation Segment 3			1.08†	.81***	.75***	.73***	.72***	.72***	−.08	.01	.00
4. Dyadic Regulation Segment 4				1.36†	.92***	.93***	.88***	.88***	−.18**	−.01	.00
5. Dyadic Regulation Segment 5					1.30†	.97***	.89***	.86***	−.16**	−.01	.00
6. Dyadic Regulation Segment 6						1.39†	1.03***	.99***	−.16**	−.01	−.01
7. Dyadic Regulation Segment 7							1.32†	.98***	−.20**	−.01	−.01
8. Dyadic Regulation Segment 8								1.28†	−.22***	−.02	−.01
9. Frequency of Marijuana Use									2.08†	.24***	.11***
10. DSM-IV Cannabis Abuse (Binary)										___††	.03***
11. DSM-IV Cannabis Dependence (Binary)											___††

Note. $^{***}p < .001$ $^{**}p < .01$ $^{*}p < .05$

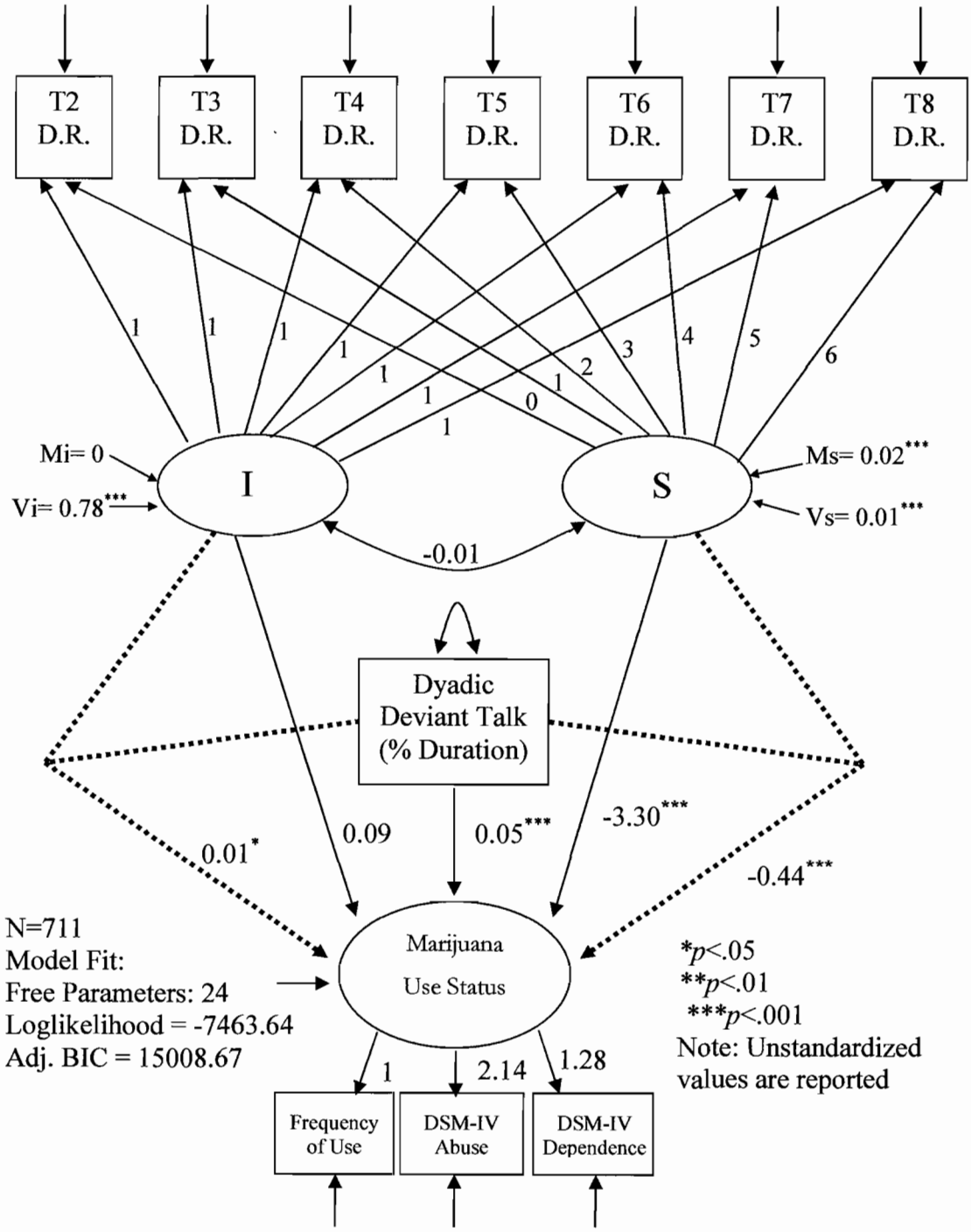


Figure 8. A marijuana use status latent growth interaction model of dyadic regulation by task including 1) percentage duration of deviant talk as a covariate; 2) the interaction between the latent slope variable and deviant talk and 3) the interaction between the latent intercept variable and deviant talk.

Figure 8 depicts the interaction between dyadic regulation slope and deviant talk in predicting marijuana use status. Those dyads with declining regulation over the course of the interaction combined with more pervasive deviant talk were especially likely to be problematic marijuana users. Dyads with more positive growth in regulation over the interaction appeared less affected by the extent of deviant talk when examining marijuana use outcomes. Figure 9 demonstrates the interaction between deviant talk and dyadic regulation intercept values in predicting marijuana use status. Those dyads with higher initial levels of regulation combined with pervasive deviant talk were at higher risk for marijuana use.

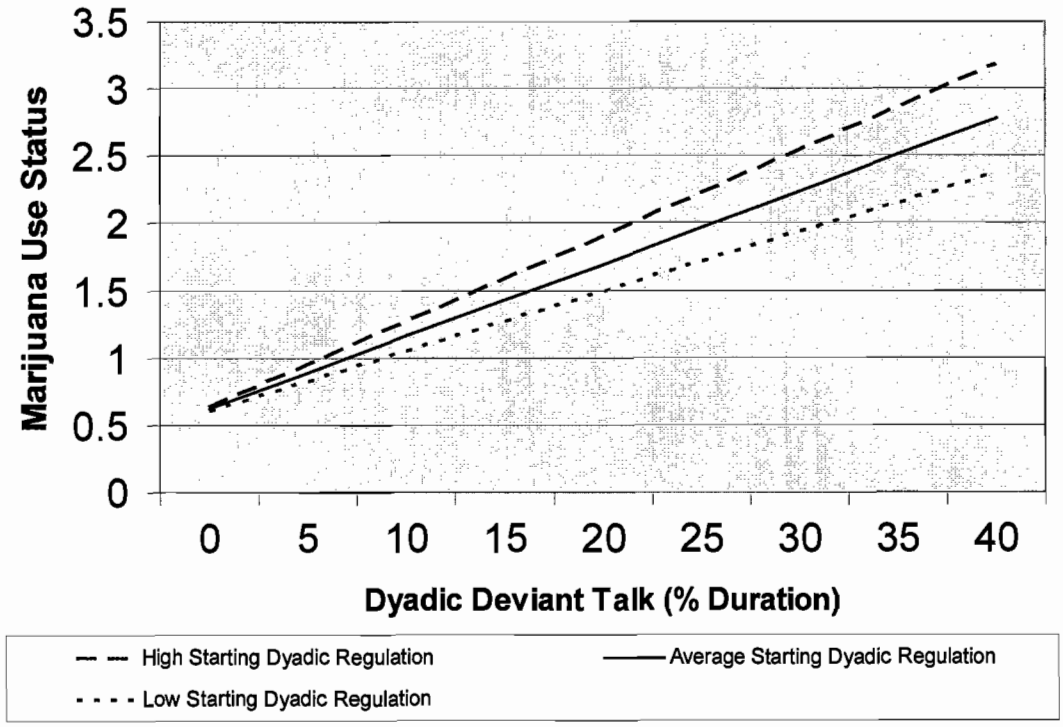


Figure 9. The interaction between percentage duration of deviant talk and rate of growth in dyadic regulation in predicting marijuana use status.

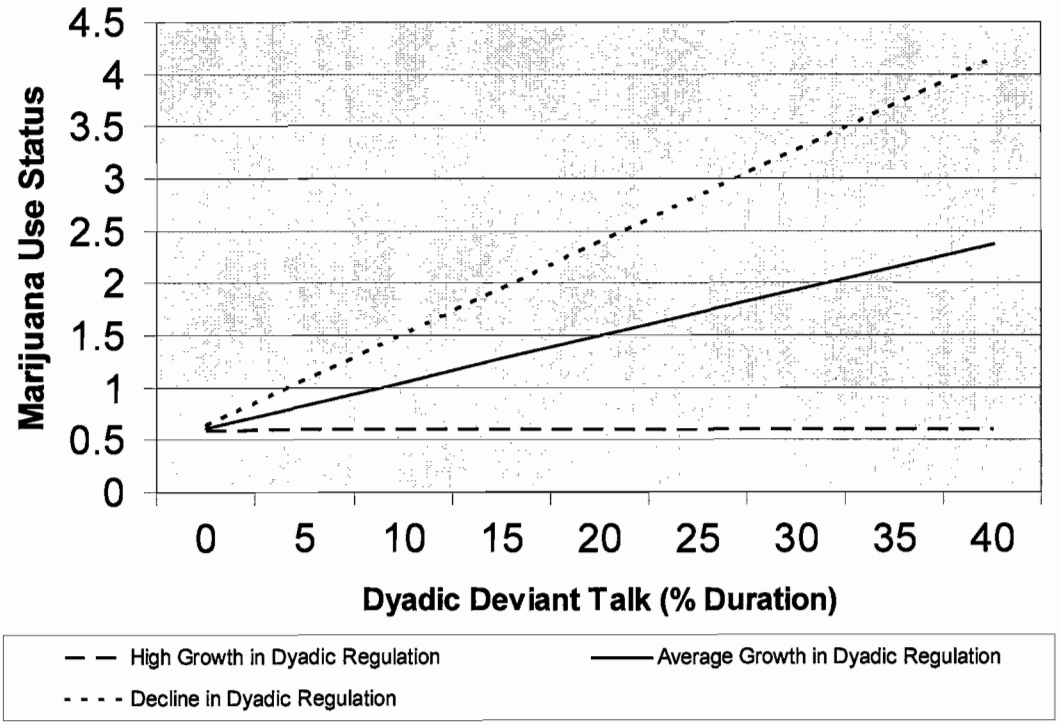


Figure 10. The interaction between percentage duration of deviant talk and dyadic regulation intercept in predicting marijuana use status.

Figure 10 depicts the tobacco use interaction LGM model (loglikelihood = −7463.64; adjusted BIC = 15008.67). Correlations for this tobacco use model are reported in Table 13, and covariances and variances are reported in Table 14. Deviant talk showed a reliable positive association with tobacco use status (b = .02, *SE* = .01; $p <$ .001). The model also revealed that the model slope was a significant negative predictor of tobacco use status (b = −1.59, *SE* = .58; $p < .01$). Those dyads with greater growth in regulation over the course of the interaction demonstrated less tobacco use compared to dyads with less growth or a decline in regulation. The model intercept and the interaction between the model slope and deviant talk were not significant contributors to the model. However, the interaction term between deviant talk and the dyadic regulation intercept

added significantly to the model (b = .01, *SE* = .004; $p < .05$). Figure 11 illustrates this interaction, revealing that those dyads with higher initial levels of regulation combined with greater duration of deviant talk were at the highest risk for elevated tobacco use.

Table 13. Correlations between tobacco use interaction latent growth model variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Dyadic Deviant Talk Percent Duration	—	−.15***	−.12**	−.20***	−.24***	−.22***	−.24***	−.22***	.19***	.04	.04
2. Dyadic Regulation Segment 2		—	.72***	.63***	.61***	.59***	.59***	.58***	−.01	.02	.00
3. Dyadic Regulation Segment 3			—	.67***	.63***	.60***	.60***	.61***	−.02	−.04	.01
4. Dyadic Regulation Segment 4				—	.69***	.68***	.65***	.67***	−.04	.01	.05
5. Dyadic Regulation Segment 5					—	.73***	.68***	.67***	−.03	−.01	.03
6. Dyadic Regulation Segment 6						—	.76***	.74***	−.03	−.01	.03
7. Dyadic Regulation Segment 7							—	.75***	−.08*	−.05	−.01
8. Dyadic Regulation Segment 8								—	−.06	−.02	.02
9. Frequency of Tobacco Use									—	.40***	.37***
10. DSM-IV Nicotine Withdrawal (Binary)										—	.41***
11. DSM-IV Nicotine Dependence (Binary)											—

Note. ***$p < .001$ **$p < .01$ *$p < .05$

Table 14. Covariances and variances of tobacco use interaction latent growth model variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Dyadic Deviant Talk Percent Duration	87.93†	−1.47***	−1.16**	−2.14***	−2.54***	−2.46***	−2.57***	−2.34***	3.41***	.07	.07
2. Dyadic Regulation Segment 2		1.16†	.80***	.79***	.74***	.75***	.73***	.71***	−.03	.00	.00
3. Dyadic Regulation Segment 3			1.08†	.81***	.75***	.73***	.72***	.72***	−.04	−.01	.00
4. Dyadic Regulation Segment 4				1.36†	.92***	.93***	.88***	.88***	−.10	.00	.01
5. Dyadic Regulation Segment 5					1.30†	.97***	.89***	.86***	−.05	.00	.01
6. Dyadic Regulation Segment 6						1.39†	1.03***	.99***	−.06	.00	.01
7. Dyadic Regulation Segment 7							1.32†	.98***	−.17*	−.01	.00
8. Dyadic Regulation Segment 8								1.28†	−.13	.00	.01
9. Frequency of Tobacco Use									3.62	.13***	.11***
10. DSM-IV Nicotine Withdrawal (Binary)										___††	.01***
11. DSM-IV Nicotine Dependence (Binary)											___††

Note. ***$p < .001$ **$p < .01$ *$p < .05$ †Variance ††No variance is provided because this is a binary variable

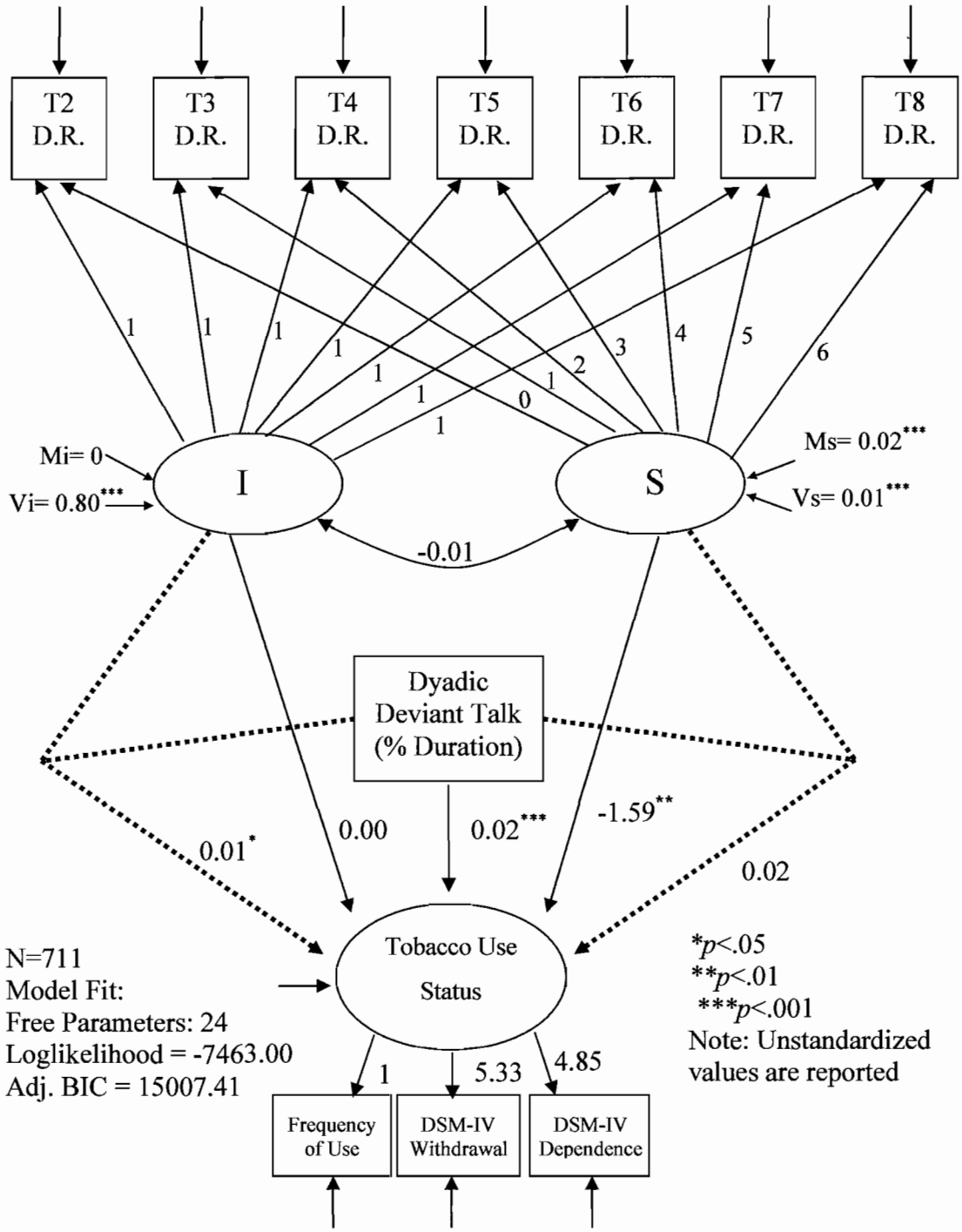


Figure 11. A tobacco use status latent growth interaction model of dyadic regulation by task including 1) percentage duration of deviant talk as a covariate; 2) the interaction between the latent slope variable and deviant talk and 3) the interaction between the latent intercept variable and deviant talk.

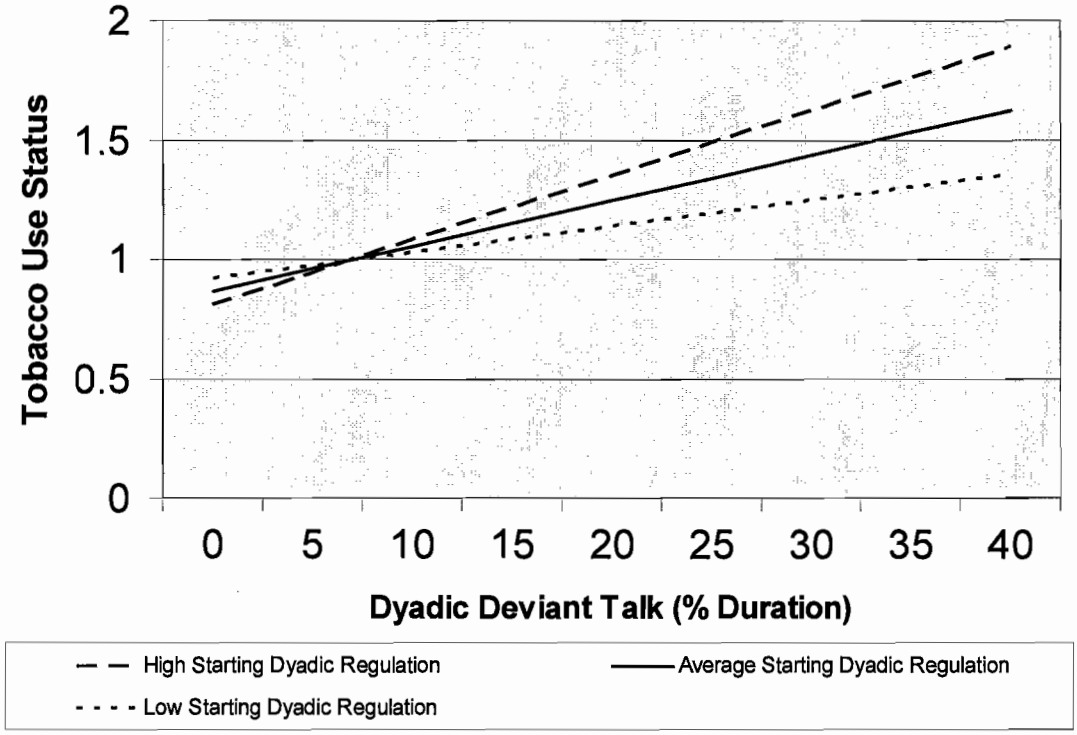


Figure 12. The interaction between percentage duration of deviant talk and dyadic regulation intercept in predicting tobacco use status.

An alcohol use interaction LGM was also estimated (loglikelihood = −7466.77; adjusted BIC = 15014.95), revealing that only percentage duration of deviant talk was a reliable predictor of alcohol use status (b = .03, *SE* = .01; $p < .001$). No other terms added significantly to the prediction of alcohol use. See Table 15 for correlations and Table 16 for covariances and variances of the alcohol use model.

Table 15. Correlations between alcohol use interaction latent growth model variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Dyadic Deviant Talk Percent Duration	—	−.15***	−.12**	−.20***	−.24***	−.22***	−.24***	−.22***	.25***	.26***	.12**
2. Dyadic Regulation Segment 2		—	.72***	.63***	.61***	.59***	.59***	.58***	−.05	−.07	.00
3. Dyadic Regulation Segment 3			—	.67***	.63***	.60***	.60***	.61***	−.03	−.02	−.02
4. Dyadic Regulation Segment 4				—	.69***	.68***	.65***	.67***	−.07	−.08*	.00
5. Dyadic Regulation Segment 5					—	.73***	.68***	.67***	−.04	−.06	.02
6. Dyadic Regulation Segment 6						—	.76***	.74***	−.07	−.05	.04
7. Dyadic Regulation Segment 7							—	.75***	−.05	−.08*	.01
8. Dyadic Regulation Segment 8								—	−.05	−.06	−.01
9. Frequency of Alcohol Use									—	.37***	.24***
10. DSM-IV Alcohol Abuse (Binary)										—	.36***
11. DSM-IV Alcohol Dependence (Binary)											—

Note. $^{***}p < .001$ $^{**}p < .01$ $^{*}p < .05$

Table 16. Covariances and variances of alcohol use interaction latent growth model variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Dyadic Deviant Talk Percent Duration	87.93†	−1.47***	−1.16**	−2.14***	−2.54***	−2.46***	−2.57***	−2.34***	3.50***	.85***	.20**
2. Dyadic Regulation Segment 2		1.16†	.80***	.79***	.74***	.75***	.73***	.71***	−.08	−.03	.00
3. Dyadic Regulation Segment 3			1.08†	.81***	.75***	.73***	.72***	.72***	−.05	−.01	.00
4. Dyadic Regulation Segment 4				1.36†	.92***	.93***	.88***	.88***	−.12	−.03*	.00
5. Dyadic Regulation Segment 5					1.30†	.97***	.89***	.86***	−.08	−.02	.01
6. Dyadic Regulation Segment 6						1.39†	1.03***	.99***	−.12	−.02	.01
7. Dyadic Regulation Segment 7							1.32†	.98***	−.09	−.03*	.00
8. Dyadic Regulation Segment 8								1.28†	−.08	−.03	.00
9. Frequency of Alcohol Use									2.23†	.20***	.07***
10. DSM-IV Alcohol Abuse (Binary)										___††	.03***
11. DSM-IV Alcohol Dependence (Binary)											___††

Note. ***$p < .001$ **$p < .01$ *$p < .05$ †Variance ††No variance is provided because this is a binary variable

The interaction LGM models were investigated by potential effects of gender, ethnicity, or intervention status. With these factors included as covariates, all of the effects were unchanged from the original models. Again, due to the use of numerical integration in the interaction models, it was not possible to run two-group models in the current version of Mplus. Models containing only participants from individual corresponding subgroups (e.g., only male, only female) were estimated and compared for any notable differences. In the marijuana interaction model, the female only model revealed that the negative main effect of the slope was reduced, whereas the negative slope main effect appeared to be strengthened in the male-only model. These differences should be interpreted cautiously because the appropriateness of a two-group model was not empirically evaluated. However, it may be that for male dyads, a decline in regulation over the course of the interaction is more strongly associated with marijuana use than for female dyads. These gender differences were not consistent for the tobacco or alcohol use models, however. No other major differences were observed in any of the models comparing intervention status or ethnicity (African-American versus European American).

CHAPTER IV

DISCUSSION

Regulation within dyadic interactions appears to be viable construct in study of adolescent friendship. Furthermore, dyadic regulation is relevant to substance use and is related to both self-regulatory ability and friendship quality. These results point towards dyadic regulation as being better understood at the dyadic-level as opposed to an individual-level construct. When considered along with processes reflective of deviant peer contagion, dyadic regulation appears to reflect aspects of both friendship quality and a limited resource model of self-regulation. While overall dyadic regulation did not appear to be directly predictive of substance use outcomes, dyads with reduced growth in regulation were associated with greater marijuana and tobacco use. Furthermore, contrary to the hypothesized direction, those dyads that were highly regulated while discussing deviant topics were more likely to have problematic tobacco use. However, when considering changes in dyadic regulation over the course of an interaction, those dyads with limited growth or a decline in regulation while more extensively discussing deviant topics were more likely to be heavy tobacco and marijuana users. These results, while complicated, are encouraging of continued use of a dyadic regulation construct in better understanding deviant peer contagion and problematic substance use during adolescence.

In addressing the question of an individual- or dyadic-level understanding of dyadic regulation, the results of the present study point strongly towards a dyadic

conceptualization. Several items comprising the regulation construct, particularly active responsiveness, demonstrated very high correlations between members of a dyad, indicating a heavy dependence on the actions of partner. Furthermore, when an adolescent participated in a second dyadic interaction, his or her regulation within that second dyad was only moderately related to the regulation observed in the first. It would appear that different partners and associated relationship characteristics effectively elicit different interpersonal behaviors and tendencies within an individual. While this dyadic conceptualization appeared most appropriate with the present analysis strategy, it seems likely that the observed regulation within a dyad may be explained through both individual tendencies and the unique characteristics brought out by the particular combination of individuals.

The present findings provided mixed support for the hypothesis that dyadic regulation would be directly predictive of substance use outcomes. Overall levels of dyadic regulation across an interaction were not directly associated with substance use status. However, the rate of change of dyadic regulation was associated with substance use, irrespective of the level of peer contagion in the interaction. Those dyads that became less regulated over the course of the interaction were more likely to demonstrate problematic marijuana and tobacco use. Consistent with a limited-resource model, youth who were unable to maintain their regulation may have more limited regulatory resources and a greater associated risk for substance use.

While not directly predictive of substance use, overall levels of dyadic regulation did appear to moderate the impact of peer contagion. But contrary to expectations, those

dyads with greater overall or initial levels of regulation and more pervasive discussion of deviant topics were found to demonstrate poorer substance use outcomes. These youth were generally more regulated and engaged in their discussion of antisocial acts, whereas dyads who were generally less regulated over deviant discussion appeared less likely to be as entrenched in the associated behaviors.

While the interaction between dyadic regulation and deviant contagion is not consistent with a self-regulatory resilience model, it is consistent with past work examining observational dynamics associated with close friendship and associated deviant influence. Piehler and Dishion's (2007) study examining dyadic mutuality in adolescent dyads similarly found that close friendship processes combined with extensive deviant discussion predicted greater levels of antisocial behavior. Furthermore, Dishion, Nelson, et al.'s (2004) finding that greater structural predictability within dyadic interaction in antisocial dyads was predictive of more antisocial outcomes is also consistent. These findings along with those of the present work implicate observed dynamics associated with interpersonally skilled and closely bonded youth as potentially heightening the influence process. It would seem that friendships closely and comfortably bonded over deviant content are especially problematic.

Change in dyadic regulation over the course of an interaction also moderated the impact of deviant peer contagion. Those dyads that combined a decline in regulation with extensive deviant discussion content were particularly likely to be heavy marijuana users. This finding is consistent with Vohs and colleagues' limited-resource model of self-regulation. Peer interactions, particularly in an unfamiliar setting, are likely to be taxing

to adolescents' self-regulatory resources as they struggle to manage the impression they are making both on their friend and potentially the research staff. Vohs and colleagues' (2005) study found such self-presentation management to notably tax self-regulatory resources, subsequently resulting in impaired performance in tasks requiring self-regulation. Furthermore, Vohs et al. also found that interpersonal skills became impaired when self-regulatory resources became overly taxed. Adolescents with more limited self-regulatory resources may have demonstrated a decline in their ability to effectively regulate themselves over the course of the interaction. Those adolescents with more limited resources may be particularly vulnerable to peer influences to use substances in related social settings. With their resources sufficiently taxed, these youth may find it particularly difficult to resist the immediate reinforcement of yielding to peer influence rather than weighing the longer term implications of such a choice.

From a resilience perspective, those youth with deeper self-regulatory resources who are better able to maintain their regulation over the course of an interaction appear better able to resist the effects of deviant peer contagion. Abstaining from substance use when faced with peer use likely requires the inhibition of a prepotent response to yield to peer norms and influence and a higher level of future planning and consideration of potential consequences. In a social setting typical of substance use, adolescents with greater resources may find themselves better able utilize the considerable self-regulation necessary for such a task.

The present results appear to yield somewhat contradictory findings regarding whether regulation in a friendship predicts either greater risk or resilience to deviant peer

contagion. On the one hand, friendships that are both highly regulated and antisocial appear to predict increased adherence to antisocial values. On the other hand, youth with more persistent dyadic regulation seem to be less impacted by deviant contagion. The relationships between dyadic regulation and the related constructs of friendship quality and self-regulation may help account for these opposing processes. These findings indicate that initial levels of dyadic regulation may be more strongly associated with friendship quality, whereas the rate of change of dyadic regulation is more strongly associated with self-regulation (though only at a trend level). Closer bonding, perhaps reflected by elevated overall or initial levels of dyadic regulation, may increase the effects of peer contagion. However, maintaining a high quality interaction for an extended period of time is likely to be taxing on regulatory resources, causing some youth to decline in regulatory behaviors. Youth with greater resources in this regard then show decreased effects of contagion, consistent with a resilience model. An important future direction would be to better isolate the specific interpersonal dynamics reflective of both regulation and close friendship processes.

These results demonstrated some notable variations by substance, reinforcing the value of examining substance specific models. While tobacco and marijuana use models demonstrated more reliable effects relative to dyadic regulation, alcohol use was not significantly associated in the models examined. Alcohol use was most prevalent among the sample and perhaps due to its widespread use is less strongly associated with the discussed problematic peer dynamics. The unique linkage between tobacco and self-regulation has been examined in some previous research. In one study, youth with

attention regulation problems have been found to be more prone to use tobacco, and in turn, those youth who used tobacco performed better on a behavioral attention network task of attention control (Gardner, Dishion, & Posner, 2006). The authors surmise that the use of tobacco just prior to the task that accounted for the increased attention abilities, consistent with tobacco's well-known regulatory effects on some facets of attention (Gardner, Dishion, & Posner, 2006). To some extent, the use of tobacco may allow youth to "self-medicate" for poor self-regulatory abilities. Marijuana use in the present sample represented the highest rate of substance-related diagnoses despite a considerably lower prevalence of use than alcohol. Youth with heavy marijuana use may represent the more problematic general substance users of the sample, perhaps explaining some of the stronger effects seen in the marijuana models. In general, it is difficult to adequately explain substance specific findings because there is little existing research comparing substance specific effects for the processes examined in the present work. Further research will clearly be important in elucidating the differing patterns of risk and resilience for each substance.

The present study is not without some limitations. First, a few methodological issues are important to note when considering the findings. In coding the peer interaction tapes, a single research assistant coded each tape, including both members of the dyad, thus the correlations between the ratings given to each member of the dyad may be inflated. Furthermore, the same research assistant both evaluated the conversational topics and gave dyadic regulation ratings for each tape, thus this relationship could be similarly inflated. It may be advisable to have independent coders evaluate each member

of the dyad as well as utilize each coding system in future work. Second, as discussed previously, some adolescents participated in multiple dyads. While this provided interesting data on the consistency of regulation across dyadic partners, the data from all dyads are not fully independent. Because of the dyadic rather than individual focus of the analyses and the fact that these dyads appeared to have some systematic differences from the rest of the sample, these "overlapping" dyads were included in analyses. Third, the growth modeling approach used to examine changes in regulatory behaviors over the course of the interaction is mildly problematic. Because a consistent order of discussion topics was assigned to each dyad, it is possible that certain types of youth responded differently to different topics. Thus, the changes of regulation observed could reflect topic-related differences in regulation as opposed to more general changes over the course of the interaction. Future work may better control for this by using differing topic orders, or by using generally unstructured interaction tasks without assigned topics of discussion. Furthermore, the overall dyadic regulation scores differed somewhat from the segment-level scores due to some additional overall items. Ideally, the segment level scores and overall scores would correspond exactly. Fifth, the present study did not consider comorbid conduct problems. It is possible that a shared association with other problem behaviors inflated the association between the regulatory behaviors examined and substance use. Finally, while it is tempting to infer causality in the present data, the study was cross-sectional and not experimental in design. Future longitudinal work may better examine the long term implications of the dynamics observed in the present study.

These results are encouraging of future work in understanding and identifying the

interpersonal dynamics associated with risk and resiliency to peer contagion. These findings, like many others, highlight the dangers of close friendships that are centered around antisocial values. Future longitudinal work examining the stability of these peer dynamics, as well as the stability of the friendships themselves, would be particularly useful in understanding the full impact of close, antisocial friendships on long term adjustment.

The present study focused on a dyadic-level regulation construct. While beyond the scope of the present analyses, future work may better identify and isolate individual-level contributions of each member of the dyad from dyadic level processes. A microsocial coding system targeting dyadic regulation in addition to increasingly sensitive global ratings would be a promising approach. Furthermore, utilizing both hierarchical and dynamic systems analyses may be useful in better isolating individual and dyadic level features, a critical future direction in better understanding these processes. An interesting future direction of this work would be to examine adolescents' individual interaction tendencies and the selection of their friends with regard to resulting regulatory dynamics of the friendship. It may be that some youth enjoy the company of others with superior interpersonal regulatory skills (perhaps even to compensate for their own interpersonal difficulties), while others seek the unpredictability or challenge of friends who tend to be less regulated in their interactions.

The knowledge of specific interpersonal behaviors associated with resiliency to deviant peer contagion has considerable potential for improving substance use interventions. First, findings in this area could guide the creation of more effective

preventative interventions that specifically target behaviors and skills associated with increased regulatory resources relevant to deviant contagion. Second, these types of findings may help address the issue of iatrogenic effects in group interventions targeting adolescent substance use. Iatrogenic effects associated with group interventions for adolescent antisocial behavior and substance use represent a major obstacle in the treatment of this population (Dishion & Dodge, 2005; Dishion, McCord, & Poulin, 1999; Gifford-Smith, Dodge, Dishion, & McCord, 2005). The few studies that examine the group dynamics associated with iatrogenic effects reveal that peer contagion among youth in an intervention group contributes to individual differences in long-term, negative outcomes (Dishion et al., 2001). The continued identification of potential moderators of peer contagion effects in intervention settings represents a significant step toward developing more effective group interventions for substance-using adolescents. By targeting interpersonal regulatory abilities relevant to peer contagion, the efficacy of group interventions could be improved. Indeed, self-regulatory abilities have been demonstrated to be responsive to adolescent- and child-focused intervention (Dishion & Stormshak, 2006), thus representing a potentially malleable target for reducing peer contagion in an intervention setting. Continued work is clearly needed in this area in order to adapt the present findings to an intervention context. However, perhaps through further careful studies of the dynamics relevant peer contagion, there is an opportunity to make a substantial contribution to positive adjustment in youth.

APPENDIX

DYADIC REGULATION CODING ITEMS FOR THE PEER INTERACTION TASK

Each of the following items is rated on a 1–9 point scale. Ratings for each item are given either at the completion of each 5-minute task or following the entire interaction as specified for each item below. At each rating point, two sets of ratings are given, one for the primary participant (target child) and one for their friend (peer).

Activation Control:

1. Was responsive to the friend's questions, comments, and behavior. Responses may be verbal (acknowledging and responding relevantly to comments) or nonverbal (e.g., acknowledging through nodding).

Rated for each segment:

(1) Rarely responds or attends to partner's comments, questions, and behaviors, even to those that directly invite a response and predominately responds with irrelevant comments.

(5) A moderate amount of responsiveness, responds with relevant responses or non-verbal acknowledging behavior to about half of partner's comments and questions, and behaviors, although some responses may be delayed.

(9) Always responds immediately and relevantly to partner; expands on many comments made by partner; seems to carefully consider partner's statements and experiences.

Inhibitory Control/Impulsivity:

1. Tended to intrude with personal ideas and experiences (e.g., self-focusing, interrupting, dominating, or dwelling on personal issues).

Rated for each segment:

(1) No evidence of impulsive intrusions – focuses a normal amount on personal ideas and experiences; seems to be able to put his or her needs and interests aside while listening to the friend.

(5) Moderate amount of intrusions – personally directed intrusions occur regularly

(9) Highly intrusive throughout – impulsive personally directed intrusions occur steadily throughout the interaction and are highly disruptive to the interaction

2. Took turns speaking, allowing partner a fair share in conversation, didn't interrupt.

Rated once for entire interaction:

(1) Appropriate turn taking– maintains a balanced interaction, waiting for partner to finish taking before speaking.

(5) Moderate amounts of inappropriate turn taking – regularly unbalanced interaction due to interrupting and/or not allowing partner adequate speaking time.

(9) Highly inappropriate turn taking – highly unbalanced interaction with nearly complete domination of conversation throughout the interaction

Attention:

1. Did not seem to attend to partner's statements (didn't use listening behaviors such as eye contact and head nodding, often talked on different tracks, followed own train of thought, changed subject abruptly, focused on camera or "audience" instead of partner). Rated once for entire interaction:

(1) Fully attentive to partner's comments, appeared to listen carefully, responses demonstrate appropriate understanding of partner's comments, directing responses toward partner

(5) Moderate amounts of inattention to partner's comments; variable listening behaviors, somewhat inappropriate responding including off-topic responses not directed towards partner

(9) Completely inattentive to partner's comments throughout the interaction, demonstrated few to no listening behaviors, inappropriate responses, did not direct responses toward partner

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