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Dyadic Coregulation and Deviant Talk in Adolescent Friendships: Interaction Patterns Associated With Problematic Substance Use in Early Adulthood

Timothy F. Piehler and
University of Minnesota and University of Oregon

Thomas J. Dishion
Arizona State University and University of Oregon

Abstract

In a sample of 711 ethnically diverse adolescents, the observed interpersonal dynamics of dyadic adolescent friendship interactions were coded to predict early adulthood tobacco, alcohol, and marijuana use. Deviant discussion content within the interactions was coded along with dyadic coregulation (i.e., interpersonal coordination, attention synchrony). Structural equation modeling revealed that, as expected, deviant content in adolescent interactions at age 16–17 years was strongly predictive of problematic use of tobacco, alcohol, and marijuana at ages 22 and 23. Although dyadic coregulation was not directly predictive of early adulthood substance use, it did moderate the impact of deviant talk within the dyad on future alcohol and marijuana use. For these substances, high levels of dyadic coregulation increased the risk associated with high levels of deviant talk for problematic use in early adulthood. Results held when comparing across genders and across ethnic groups. The results suggest that these interpersonal dynamics are associated with developmental trajectories of risk for or resilience to peer influence processes.

Keywords

adolescence; early adulthood; substance use; peer influence; interpersonal dynamics

Interpersonal relationships play a critical role in positive adjustment throughout development. Beginning with the parent–child dyad, observational research has demonstrated that infants and young children learn to regulate their emotions and behaviors through responsive and reciprocal interactions with their caregivers (e.g., Evans & Porter, 2009; Feldman, 2007). Later in development, children's major interpersonal focus shifts from their parents toward peers. Children apply the self-regulatory and interpersonal skills developed in their earlier parent–child relationships toward navigating increasingly complex peer interactions (Buhrmester, 1990; Ladd, 1999). In adolescence, peer relationships often

Correspondence concerning this article should be addressed to: Timothy F. Piehler, Department of Psychiatry, University of Minnesota Medical Center, 2450 Riverside Avenue, Minneapolis, MN 55454. tpiehler@umn.edu.
Timothy F. Piehler, Department of Psychiatry, University of Minnesota, and Child and Family Center, University of Oregon; Thomas J. Dishion, Department of Psychology, Arizona State University, and Child and Family Center, University of Oregon.

take on paramount importance in either promoting positive development or placing youth at risk for negative developmental outcomes (e.g., Criss, Pettit, Bates, Dodge, & Lapp, 2002; Dishion & Tipsord, 2011; Gifford-Smith & Brownell, 2003). Indeed, many behaviors such as substance use and abuse that are problematic in adulthood have their origins in adolescent peer relationships (Piehler, Véronneau, & Dishion, 2012).

In understanding the implications of important interpersonal relationships for child and adolescent development, many researchers have argued that such relationships are best examined as a dynamic, transactional process (Bakeman & Gottman, 1997; Dishion & Snyder, 2004; Reis & Shaver, 1988). A process-oriented approach to understanding relationship dynamics allows critical dimensions of social interactions to be disentangled. Both content of interactions (e.g., topics of discussion) and interpersonal process (e.g., style of interaction) represent independent dimensions of relationship processes. Although interaction content and interpersonal process may each play unique roles in relationships and their associated impact, these two dimensions are likely to interact in determining a relationship's influence on subsequent development (Dishion, Nelson, Winter, & Bullock, 2004; Piehler & Dishion, 2007; Snyder et al., 2008).

Although the developmental significance of the well-regulated interactions within parent–child dyads, often termed *dyadic co-regulation*, has been demonstrated (e.g., Lunkenheimer, Olson, Hollenstein, Sameroff, & Winter, 2011), much less is known about the role of these interpersonal processes within adolescent peer relationships. Dyadic coregulation within peer relationships represents the process by which two youths are interpersonally synchronous, reciprocal, and regulated in their interactions. The focus of research on this construct has been on parent–child dyads, and the few studies that have assessed dyadic coregulation and related constructs within peer interactions have focused on normative friendships. One study noted that higher levels of traits associated with dyadic coregulation were found in closer friendships in middle childhood (Newcomb & Brady, 1982). Related constructs such as intimacy and friendship quality in child and adolescent friend-ships are often associated with positive developmental outcomes such as higher self-esteem, improved social adjustment, and lower levels of emotional and behavioral problems (Bagwell et al., 2005; Berndt, 2002). Thus, within normative friendships, close friendship processes such as dyadic coregulation appear to be broadly protective factors. However, some such positive friendship interaction qualities have been noted to be equally present in both antisocial and normative friendships (Dishion, Andrews, & Crosby, 1995). The role of these positive interaction qualities in antisocial friendships remains unclear. Therefore, the current study sought to better understand the role of dyadic coregulation in antisocial friendships with interactions centered around deviant content.

Specific peer dynamics have been associated with the development and maintenance of problem behaviors, particularly substance use and abuse. Using observational measures, Dishion, Spracklen, Andrews, and Patterson (1996) described a specific interactional process of peer influence known as *deviancy training* that predicted escalations in several forms of adolescent problem behavior. They used sequential time series analyses to identify youths engaging in 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 deviant topics. Deviancy training has been associated with increased probability of substance use initiation and self-reported delinquency during a 2-year period (Dishion, Capaldi, Spracklen, & Li, 1995; Dishion et al., 1996), increased violent behavior and conduct problems (Dishion, Eddy, Haas, Li, & Spracklen, 1997; Snyder et al., 2005), and increased iatrogenic effects in group interventions (Dishion, Poulin, & Burraston, 2001).

Relatively few specific moderating effects associated with either increased risk or resiliency to deviant peer influence processes such as deviancy training have been identified. However, past research is suggestive that dyadic coregulation could serve as a potential moderator. One such study found that observable indicators of a close friendship, such as responsiveness, emotional reciprocity, and shared understanding of language seemed to moderate the extent of deviant influence within peer dyads (Piehler & Dishion, 2007). Interestingly, for youths who extensively discussed deviant content, more positive interactions were found to predict the highest levels of antisocial behavior. However, for youths with little antisocial discussion, these positive interactions appeared to be a protective factor in the development of antisocial behavior. Reflecting principles of social learning theory (Bandura, 1977), more positive friendship interactions appeared to predict the greatest engagement in and commitment to the norms of that friendship, whether antisocial or normative.

Implicit in dyadic coregulation is youths' ability to effectively regulate their behavior in an interpersonal context. Notably, individual-level measures of self-regulation, such as effortful control and impulsivity, have been implicated as moderators of peer influence on delinquent and substance-using behaviors in adolescence (Piehler et al., 2012; Vitulano, Fite, & Rathert, 2010). For adolescents with high levels of exposure to deviant peers (reflective of more extensive peer influence), high levels of self-regulation surprisingly increased risk for problematic substance use and delinquent behavior. For youths with few associations with deviant peers, high self-regulation was protective and predicted fewer of these problematic behaviors. Like positive friendship qualities, self-regulation is generally thought of as a protective factor (e.g., Lengua, 2002). However, within the context of a high-risk peer environment, self-regulation appears to increase rather than decrease risk.

These findings point toward close friendships and well-regulated behavior functioning differently in adolescence depending upon the extent of associated peer risk. At low levels of exposure to deviant peer influence, having strong intrapersonal (e.g., effortful control) and interpersonal skills (e.g., positive friendship interactions) appears to be a protective factor for growth in antisocial behavior and substance use. However, for those youths already in a high-risk peer environment, these skills appear to place them at higher risk for associated negative developmental trajectories. These highly regulated and interpersonally skilled youths might be the most likely to form closer bonds with deviant peers and jointly engage in goal-directed and planful antisocial behavior and substance use. Their deep enmeshment in deviant relationships and a large antisocial peer group places these youths at increased risk of persisting with antisocial behavior and substance use later in development.

In order to examine the implications of observed adolescent peer interaction dynamics for subsequent development, outcome measures focused on problematic substance use in early adulthood. Problematic substance use can be seen as a developmental disorder, with the onset of use often occurring in adolescence and a peak in use during early adulthood (Chen & Jacobson, 2012; Wagner & Anthony, 2002). Because adolescent peer groups typically serve as the setting for the initiation of substance use and associated influence, peer interactions during this developmental period might be particularly relevant for understanding why some youths transition from experimental use in adolescence to patterned, problematic use by early adulthood (Dishion, Capaldi, et al., 1995). This study focused on substance use outcomes that are indicative of problematic use, including symptoms of abuse and dependence, in addition to frequency of use. Because the development of problematic use of individual substances (i.e., alcohol, tobacco, and marijuana) might have unique etiologies and risk factors during adolescence, each substance was examined as a distinct outcome.

This research investigated the role of adolescent dyadic coregulation and deviant discussion in predicting problematic substance use in early adulthood. We sought to better understand the role of dyadic coregulation as a moderator of the impact of deviant peer influence as observed in dyadic interactions. The extent of deviant discussion content was observed and measured as a proxy for deviant influence within a friendship (Granic & Dishion, 2003; Piehler & Dishion, 2007). Specifically, it was hypothesized that high levels of dyadic coregulation would increase the risk for future problematic substance use resulting from deviant discussion.

Method

Overview

Data for the proposed analyses were 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). All sixth grade students from several targeted middle schools were approached for participation. A randomly selected sample of 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. The intervention is described in greater detail elsewhere (Connell, Dishion, Yasui, & Kavanagh, 2007; Dishion & Kavanagh, 2003; Dishion & Stormshak, 2007). Approximately 80% of the original sample of participants provided data at the sixth wave of data collection at age 16 or 17 years. At two follow-up assessment points in early adulthood, approximately 82% of the original sample provided data at age 22 (Wave 8) and approximately 84% at age 23 (Wave 9).

Sample

The full Project Alliance sample underwent multiple assessment waves of videotaped observations and a variety of survey instruments that were given to 998 adolescents, their

families, and their teachers. Adolescents and their teachers were primarily surveyed in their schools, and other family members were primarily surveyed through mailed questionnaires. Adolescents also completed additional videotaped observation tasks with an identified friend (i.e., peer interaction task) at a research institute in Grade 11 (Wave 6; ages 16–17). Early adulthood assessments were conducted primarily through the mail. At recruitment, the entire sample comprised 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.

Our study focused on three primary assessment points from this larger longitudinal study, including Waves 6, 8, and 9. Beginning with Wave 6 of data collection, participants were in 11th grade and between 16 and 17 years old. Two early adulthood follow-up assessments were also collected when participants were approximately age 22 (Wave 8; average age = 22 years and 3 months, *SD* = 7.5 months) and approximately age 23 (Wave 9; average age = 23 years and 4 months, *SD* = 7.8 months). Data from both Wave 8 and Wave 9 were included in analyses in order to maximize the number of participants with follow-up data. A total of 998 children and their families completed the initial assessment in the sixth grade (i.e., 90% of the targeted population). Of those, 802 provided some data in the 11th grade, including 711 participants who brought in a friend to participate in the peer interaction task (PIT) in Grade 11. Of the original sample, 815 participants provided some data at Wave 8 and 835 provided some data at Wave 9, with 880 participants providing some data at either Wave 8 or Wave 9.

Because of the focus on peer interactions, data from only those 711 participants who completed the PIT were included in analyses. The demographic characteristics of the 711 participants who participated in the PIT at Wave 6 of data collection remained consistent with those of the sample at recruitment. The sample who participated in the PIT consisted of 45.0% European American adolescents, 30.1% African American adolescents, 5.6% Hispanic adolescents, 4.6% Asian or Pacific Islander adolescents, 1.8% Native American adolescents, and 12.8% adolescents with multiple ethnic or racial backgrounds. Participants were divided approximately equally by gender (355 males; 356 females) and intervention status (344 intervention; 367 control). See the results section for an additional examination of differences between the intervention and control groups. From the original sample at recruitment, the 711 participants who completed the PIT demonstrated some differences from those participants who did not complete the PIT (n = 287) at Wave 6. The participants who completed the PIT were more likely to be ethnic minorities, and they reported a higher frequency of alcohol and marijuana use in early adulthood than those participants who did not complete the PIT. The reason for these differences is not fully clear. Of the 711 participants who participated in the PIT in Grade 11, 639 provided Wave 8 data and 646 provided Wave 9 data, with 674 (95%) providing data at either wave. Demographic characteristics of the participants who provided data at either wave in early adulthood again remained highly consistent with those of the initial sample, including by gender, ethnicity, and intervention group membership.

Procedures

Peer interaction task—In Grade 11 (ages 16 and 17), study participants took part in a videotaped interaction task with a same-sex, self-nominated friend. 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-min, videotaped discussion covering a wide range of predetermined topics. Adolescents and peers each provided informed consent. The PIT was designed to elicit a wide range of interactive behaviors within the dyad; similar procedures were used in an earlier study by Piehler and Dishion (2007). Eight different topics were discussed for 5 min each in the following fixed order for all dyads, including (a) planning an activity together (something they could potentially do together in the next week), (b) a currently nominated problem of the adolescent, (c) a currently nominated problem of the peer, (d) drug and alcohol use, (e) goals for the next year, (f) friends and peer groups, (g) dating, and (h) 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. All topics were presented in a nonjudgmental manner, and participants were encouraged to openly discuss their ideas about each topic in detail. Some adolescents brought in peers who were also participants in the Project Alliance study. Of the 711 dyads who participated in the PIT, 101 included an adolescent who had also participated in another dyad. This practice was allowed in the interest of observing adolescents interact with friends with whom they were the most comfortable and because of recruitment of students in the same or adjacent schools. See the Results section for further discussion of the issue of the nonindependence of these dyads.

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 coding systems: the Topic Code (Piehler & Dishion, 2004), which focused on measuring durations of "deviant" talk, and the Peer Interaction Task Coder Impressions Questionnaire (Dishion, Peterson, Piehler, Winter, & Woodworth, 2006), which included ratings relevant to dyadic coregulation. Each coder viewed each videotape in two passes, first using all codes for the study adolescent and second using all codes for the peer. Coders could rewind and pause the videotapes to evaluate difficult sections. Approximately 15% of the data (108 tapes) were randomly sampled and coded by two individual coders to assess reliability.

Deviant talk—Deviant talk in the PIT was assessed through implementation of the Topic Code (see Dishion et al., 1996, for more information). The Topic Code was implemented using the Observer Pro (Version 5.0, 2003) coding program run on a personal computer, which enabled precise measurements of durations of deviant content during the PIT. Deviant talk was coded for all verbal and nonverbal behavior that was not appropriate to the setting or task or that violated community or societal rules. Examples are references to 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. A percent duration score of deviant talk was used, which simply refers to the percentage of the total time an individual engaged in deviant talk. The percent duration scores for each member of the dyad were averaged to form an overall percent duration score for the dyad. A larger percentage of the interaction devoted to discussing deviant topics was thought to reflect more extensive deviant influence within the dyad.

Dyadic coregulation—Dyadic coregulation reflects the level of interpersonal synchrony, mutual attention control, and conversation coordination during the PIT. This construct was assessed using four items relevant to interpersonal behaviors, including (a) attention control (i.e., “does the adolescent maintain attention focused onto their dyadic partner?”), (b) activation (i.e., “does the adolescent actively participate and respond to their partner during the interaction?”), (c) inhibition (i.e., “does the adolescent demonstrate excessive self-focused intrusions?”), and (d) reciprocity (i.e., “does the adolescent allow conversational turn taking without excessive interruptions?”). Ratings were given to each member of the dyad separately. All items were rated on a 9-point Likert-type scale (e.g., 1 = *rarely or never*, 5 = *a moderate amount*, 9 = *always or throughout*). The inhibition item was reverse scored so that like the other items, a higher score indicated more regulatory behaviors. Ratings regarding attention control and reciprocity were provided once by coders for each member of the dyad describing the full PIT. Ratings regarding activation and inhibition were repeated by coders for each member of the dyad after each of the seven 5-min topic segments within the PIT. For these two items, the series of ratings were then each averaged into single scores for each member of the dyad that described the full PIT. Thus, for each member of the dyad, four total scores (i.e., attention control, reciprocity, activation, and inhibition) describing the full PIT were then averaged to create dyadic coregulation scores. This score had standardized alpha reliabilities of .79 for the adolescent and .79 for the peer.

Coding reliability—Fifteen percent of the data were coded twice to assess reliability. In the implementation of the Topic Code, several additional codes were also included that were not a part of the present analyses (e.g., pauses, assenting). By design of the software, the only reliability information available includes coders’ performance on all codes simultaneously, including these other codes in addition to the coding of deviant talk. Including these other codes, coders maintained adequate reliability using the Topic Code (κ = .79; 82% agreement), allowing for a code (e.g., deviant talk) to be recorded within a 6-s margin of error. This 6-s margin of error and the associated observed level of reliability are acceptable and consistent with other studies in this area using precise measurements of observational codes (e.g., Dishion et al., 1996; Granic & Dishion, 2003; Pepler & Craig, 1995; Piehler & Dishion, 2007).

In coding dyadic coregulation, coders maintained 80% agreement, allowing for 2-point discrepancies between ratings on tapes coded twice for reliability. This level of agreement is again consistent with previous work utilizing coder ratings of peer interactions (e.g., Dishion et al., 2001; Piehler & Dishion, 2007).

Early Adulthood Measures

Early adulthood problematic substance use—Substance use in early adulthood was assessed at two time points, at ages 22 (Wave 8) and 23 (Wave 9). At each assessment point, two primary scores were created with respect to evaluation of early adulthood problematic substance use, including measures of frequency of use and symptoms of abuse/dependence for each substance evaluated. At the two assessment points, participants indicated the frequency of their use of cigarettes, alcohol, and marijuana on 8-point scales ranging from *never* to *2–3 times a day or more* for each substance.

Participants were also asked questions about behaviors that could reflect either substance dependence or substance abuse for each substance. The items were modeled on items in the Composite International Diagnostic Interview (CIDI; Version 2.1; Robins et al., 1988) and included “Have you tried to stop using [a substance] and found you could not?” (used for all substances); “When you used [this substance], did you get high?” and “Have you found that you can’t get as high on [this substance] as you used to?” (used for alcohol and marijuana); “Have you ever gone to school or work when you were high on [this substance]?” and “Have you ever had any problems related to school or work, such as not doing assignments or forgetting things because of [this substance]?” (used for marijuana). All those questions were answered by *yes* or *no*. For the “… did you get high?” item, an additional question followed for those who responded in the affirmative, asking “How high did you get?” Participants responded on a 3-point scale to indicate if they got “a little,” “quite a bit,” or “very much” high. For scoring this item, participants’ responses were combined with the previous item and placed on a scale between 0 and 1, such that possible scores included 0 (*did not get high*), .33 (*a little high*), .66 (*quite a bit high*), and 1 (*very much high*). All other items were scored such that a *no* response was coded 0 and a *yes* response was coded as 1. Items relevant to each substance were summed to form total abuse/dependence scores for each substance at each assessment point.

Analysis Strategy

Structural equation models were estimated using the structural equation modeling program Mplus (Version 6; L. K. Muthén & Muthén, 2010). A single main effects model was run including deviant talk and dyadic coregulation as predictors of tobacco use, alcohol use, and marijuana use outcomes in early adulthood. The latent dyadic coregulation construct had two indicators, including coregulation scores of the adolescent and the peer. Each latent substance use outcome had four indicators, including measures of frequency of use and symptoms of abuse/dependence at age 22 and an additional set of these measures collected at age 23. In order to account for the local dependence of the shared item wording across time points for both the frequency and abuse/dependence indicators, the residuals of the corresponding age 22 and age 23 indicators were allowed to covary within each latent construct.

An interaction term between deviant talk and the latent dyadic coregulation construct was added into the model as a subsequent step. All variables (latent or observed) were centered around their means when used in creating interaction terms. 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 that treats the interaction effect as a nonlinear term, identifying model parameters through analysis of the joint multivariate distribution of observed variables (Huang & Bentler, 2009). This approach is appropriate for modeling the interaction between a continuous latent variable and continuous observed variable (L. K. Muthén & Muthén, 2010). 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 B. O. Muthén and Asparouhov (2003). When estimating statistical interaction models involving latent variables, Mplus Version 6 does not compute standardized estimates of model parameters or the most commonly used fit statistics (i.e., chi-square, comparative fit index [CFI], root-mean-square error of approximation [RMSEA]). Therefore, Bayesian and loglikelihood values are provided for both the main effects and interaction models for purposes of comparison.

Some missing values were present in the data set, but adequate covariance coverage was present (a minimum of .83 across models). Missing data in all models were estimated using a maximum-likelihood estimation procedure used by Mplus. As is common with substance use data, the substance use variables demonstrated a significant amount of positive skew. To correct for this, a logarithmic transformation was used on all frequency-of-use substance use variables.

Model fit was evaluated according to Kline (2005), who indicated that a good model fit should yield a nonsignificant chi-square value but that test tends to be too conservative with larger sample sizes. In that case, other fit indices are usually preferred to assess model fit. CFI values at .90 or more, RMSEA values at .10 or less, and standardized root-mean-square residual (SRMR) values less than .10 indicate adequate model fit.

After testing the model fit for the overall sample, we examined the covariance equivalence of the main effects model across genders, across ethnic groups, and across the treatment and control group by using multiple-group analyses. In comparing ethnic groups, only those of European American (n = 320) and African American (n = 214) ethnicities had adequate representation in the sample to evaluate group differences. Because of the large sample size, the change in CFI (ΔCFI) was used to assess the significance of the difference between the multiple-group constrained models, in which correlations and regression paths were assumed to be equivalent in the two groups, and the multiple-group unconstrained models, in which correlations and regression paths were not assumed to be identical in the two groups. According to Cheung and Rensvold (2002), ΔCFI of .01 or greater indicates a significant difference between the two models. Mplus Version 6 is not able to perform multiple-group analyses in models using interaction terms involving latent variables, thus no group comparisons were possible in the interaction model.

Results

Intervention Participants

The sample was divided approximately equally into participants who were randomly assigned to the intervention (n = 344) and control (n = 367) groups. Although intervention effects were not a focus of the present analyses, these two groups were examined for any differences on variables included in the present analysis using a series of t tests. The intervention group demonstrated modest but significant differences when compared to the control group on two study variables, including lower levels of deviant talk and reduced frequency of marijuana use at age 22. All other variables included in the present analyses were equivalent between the two groups, including all other substance use measures at age 22 and all age 23 substance use measures. In addition to running multiple group analyses comparing the intervention and control groups, a set of models were also estimated including intervention status as covariate. This allowed for a more direct examination of any potential intervention effects present within the models that could be influencing substance use outcomes as well as a method to control for such effects (if present) when estimating other key model parameters.

Repeat PIT Participants

The Project Alliance sample comprised more than 90% of the community of the participating middle schools; therefore it is not surprising that some adolescents were friends with multiple participants even 6 years after the initial assessment. Of the full sample of 711 dyads completing the PIT, 101 dyads included one adolescent completing their second PIT. Although the focus of these analyses was at the dyadic level, it could be argued that these dyads were not fully independent of other dyads because of a shared member. After performing a series of t tests examining differences in all study variables for those dyads with a “repeat” member, no significant differences were revealed between these youths and those youths who only participated in a single PIT.

Although the overlap among youths in some PITs did not occur by study design, it did make possible an examination of the consistency of an adolescent’s behavior with different dyadic partners. In this subsample (n = 101), adolescents’ regulation scores demonstrated strong intraclass correlations (ICCs) with those of their dyadic partners (ICC = .57, $p < .001$). Those adolescents who completed two PITs showed only a small intraclass correlation in their own scores across trials with a different partner (ICC = .22, $p < .05$). The regulation scores of adolescents’ peers across trials (different individuals) were weakly associated (ICC = .18, $p < .05$).

Given the equivalence between “repeat” PIT participants and other participants and the relatively modest correlations between their behaviors with different dyadic partners, it was decided to retain these participants in analyses. However, to further investigate how the inclusion of these participants might have impacted key results, a subsample of dyads was randomly selected that avoided any overlapping members (n = 610). Each model was also estimated using this subsample for purposes of comparison.

Longitudinal Models

To examine the direct relationship between dyadic coregulation, deviant talk, and substance use, a path model was estimated to examine the main effects of deviant talk and dyadic coregulation on early adulthood substance use outcomes, including tobacco, alcohol, and marijuana. All substance use outcomes were included in a single model. An interaction model was subsequently estimated by adding an interaction term between deviant talk and dyadic coregulation to the main effects model. Table 1 displays the correlations, means, and standard deviations of each of the variables used in the path models.

The main effects model is shown in Figure 1. Except for a significant chi square value, fit indices for the model were acceptable, $\chi^2(72) = 312.98$, $p < .05$, CFI = .94, RMSEA = .07 (90% CI = .06–.08), SRMR = .04, loglikelihood = −9,624.96; sample adjusted Bayesian information criterion (BIC) = 19,369.94. Deviant talk was a significant predictor of early adulthood tobacco use ($\beta = .27$, $p < .001$), alcohol use ($\beta = .16$, $p < .001$), and marijuana use ($\beta = .27$, $p < .001$). Dyadic coregulation did not demonstrate a reliable main effect in predicting early adulthood use of any of the three substances examined. Deviant talk and the latent dyadic coregulation construct demonstrated a significant negative correlation ($r = -.34$, $p < .001$), meaning that better regulated dyads were likely to demonstrate less deviant talk. Early adulthood tobacco use was positively associated with early adulthood marijuana use ($r = .55$, $p < .001$) and alcohol use ($r = .41$, $p < .001$). Early adulthood alcohol use also demonstrated a strong positive correlation with marijuana use in early adulthood ($r = .69$, $p < .001$). In the main effects model, no differences in the key parameters were observed by gender, ethnicity, or intervention status. Furthermore, all main effects were consistent when intervention status was included as a predictor of substance use outcomes. Intervention status was not a reliable predictor of any of the substance use outcomes in this model. Furthermore, when including only those dyads without overlapping membership ($n = 610$), all main effects retained their significance.

An interaction path model was then estimated to test for a moderating effect of dyadic coregulation on deviant talk in predicting early adulthood substance use outcomes. In order to test this model, an interaction term between dyadic coregulation and deviant talk was added to the main effects model described above. Although standardized fit statistics were not available in Mplus due to the estimation of latent variable interaction terms, the model demonstrated equivalent nonstandardized fit indices when compared to the main effects model, loglikelihood = −9,621.64; sample adjusted BIC = 19,369.29. The model revealed that the interaction term significantly predicted early adulthood alcohol use ($b = .004$; $p < .05$) and early adulthood marijuana use ($b = .007$; $p < .05$), but not early adulthood tobacco use. See Figure 2 for a graphical illustration of the alcohol interaction effect. For dyads with more extensive deviant discussion, higher levels of coregulation increased risk for alcohol use in early adulthood. Figure 3 illustrates the marijuana interaction effect. Similarly, higher dyadic coregulation increased the risk associated with more extensive deviant talk for marijuana use in early adulthood, at least 6 years later. As noted, multiple group comparison models were not possible in Mplus for the interaction model. When intervention status was entered as a covariate to the interaction model, all effects were consistent, and it was not a reliable predictor of any substance use outcomes. When including only those dyads without

overlapping membership (n = 610) in the interaction model, all main effects and the interaction term predicting early adulthood marijuana use retained their significance. The interaction term predicting early adulthood alcohol use remained consistent in direction but was present only at the trend level.

Discussion

These analyses further our knowledge of the role of friendship dynamics associated with initiation and growth in problem behavior in adolescence and early adulthood. Clearly, our study findings emphasize the role social processes play in leading youth toward problematic substance use in early adulthood. The extent of deviant discussion in a dyadic interaction with a friend was reliably predictive of problematic substance use even 6 years after the observed interaction. Relationship dynamics, such as interpersonal synchrony, mutual attention during conversation, and maintaining a focus on the thoughts and behavior of a friend, do not appear to independently predict future problematic substance use. However, when coupled with deviant talk, these dynamics, which are commonly thought to be descriptive of healthy friendships in adolescence, are in fact prognostic of problematic use of alcohol and marijuana in early adulthood. For dyads with more extensive deviant discussion, greater dyadic coregulation seemed to increase the risk associated with that discussion for future problematic use of alcohol and marijuana. Dyads who were generally less well regulated in their interactions appeared to lower the risk associated with extensive deviant discussion. This study lends further support to the importance of disentangling the content of peer interactions from the interpersonal process.

Perhaps most important, our findings lend further support to a developing theory of friendship influence. Past work has suggested that characteristics of friendship interactions generally thought to be protective and associated with positive outcomes in normative youth might serve a different role in the friendships of antisocial youth (Dishion et al., 2004; Piehler & Dishion, 2007). These findings, along with those of the study described in this article, implicate dynamics associated with youths' interpersonal regulation and close bonding as potentially heightening the influence process. Interpersonally well-regulated friendships in which youth connect through deviant content seem especially problematic in this regard. Among friendships with high levels of deviant discussion, highly coregulated interactions may be especially reinforcing for youth, leading deviant topics to become stable, organizing features of a friendship. Close friendships characterized by such social reinforcement of the discussion of antisocial behavior and substance use appear likely to have a powerful effect on the development of problematic behavior.

Given the 6-year period after which outcomes were assessed, our findings might also reflect broader social and developmental processes beyond the influence of a single friendship. Among youth who associate with deviant peers, those youths who demonstrate the ability to form close and reciprocal relationships appear to be at risk to become more deeply enmeshed within their peer group than those youths who lack these skills. These youths may even be leaders and organizers of antisocial activity and substance use within deviant peer groups. However, behaviors such as substance use that might have promoted status and connection among peers during adolescence can become maladaptive by early adulthood.

Those youths who are less well-regulated within their antisocial friendships may be more likely to be “fringe” members of antisocial peer networks who later desist in such behavior.

These findings have implications for substance use interventions. Characteristics of youth generally thought to be predictive and promotive of positive developmental outcomes (i.e., strong interpersonal skills) might be problematic in a deviant context. Youths within deviant peer groups who demonstrate these characteristics seem to be at risk for negative substance use outcomes when they form close, antisocial friendships. If these youths can be identified and provided with opportunities to form close relationships with nondeviant peers, such an intervention could have substantial implications for their subsequent development.

Research in this area might also help address the issue of iatrogenic effects in group interventions targeting adolescent substance use. Iatrogenic effects due to peer contagion (e.g., deviancy training) within group interventions for adolescent antisocial behavior and substance use represent a major obstacle in the treatment of this population (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 & Tipsord, 2011; Engle, Macgowan, Wagner, & Amrhein, 2010). By identifying specific interpersonal characteristics that are promotive of or moderate deviant peer influence, these dynamics may be actively addressed in group-based interventions so as to minimize iatrogenic effects.

Study results demonstrated some variations by substance, reinforcing the value of examining substances individually. The presence of interaction effects predicting alcohol and marijuana use is consistent with previous work noting these substances to be more susceptible to peer influences when compared to other substances (Nation & Heflinger, 2006). Some support also exists for higher relationship quality increasing peer influence effects on marijuana use but not on use of other substances (Andrews, Tildesley, Hops, & Li, 2002). An interaction effect was not observed with tobacco use, which could reflect some of the unique aspects of this substance. Shared tobacco use among peers has been found to be particularly dependent upon selection effects rather than on direct influence (Ennett & Bauman, 1994), thus influence processes observed in this study may have a somewhat smaller impact on future tobacco use than other substances. One could also hypothesize that unique effects of tobacco use may even serve some youths to better regulate their social behavior. In one study, youths with attention regulation problems were found to be more prone to use tobacco, and in turn, those youths who used tobacco performed better on a behavioral attention network task of attention control (Gardner, Dishion, & Posner, 2006). Youths’ use of tobacco to help regulate their social interactions seems to underlie a particularly complex reciprocal dynamic that is certainly worthy of further study.

A few methodological limitations are important to note when considering our study findings. The overlap of some members between dyads produces a nonindependence issue between dyadic-level data that could have biased results. Nearly all effects were consistent upon removal of these participants, with the exception of the interaction effect for alcohol use, which was weakened to a trend level. Thus, the nonindependence of the data could have

strengthened the interaction effect. However, given the equivalence between members of a repeat dyads and the rest of the sample, the impact of including these dyads in analyses is generally thought to be minimized. Half of the study participants were assigned to an intervention group approximately 6 years prior to the completion of the PIT. These youths demonstrated differences on two out of 15 total study variables and thus could have potentially influenced the observed results. However, all primary results were consistent across both the intervention and control groups and remained consistent when intervention status was included as covariate. In the process of coding each PIT, both members of a peer dyad were coded by the same research assistant, thus the correlations between the ratings given to each member of the dyad might be inflated. Furthermore, because the same coder evaluated both the conversational topics and gave dyadic coregulation ratings for a given PIT, this relationship could be similarly inflated. It may be advisable to have independent coders evaluate each member of the dyad and use each coding system in future work.

The results of our study encourage others' future work to understand and identify the interpersonal dynamics associated with risk for and resiliency to peer influence processes. These findings, like many others, highlight the dangers of close friendships that are centered on antisocial values. Future longitudinal work that examines the stability of these peer dynamics and the stability of the friendships themselves would be particularly useful for understanding the full impact of well-regulated, antisocial friendships on long-term adjustment.

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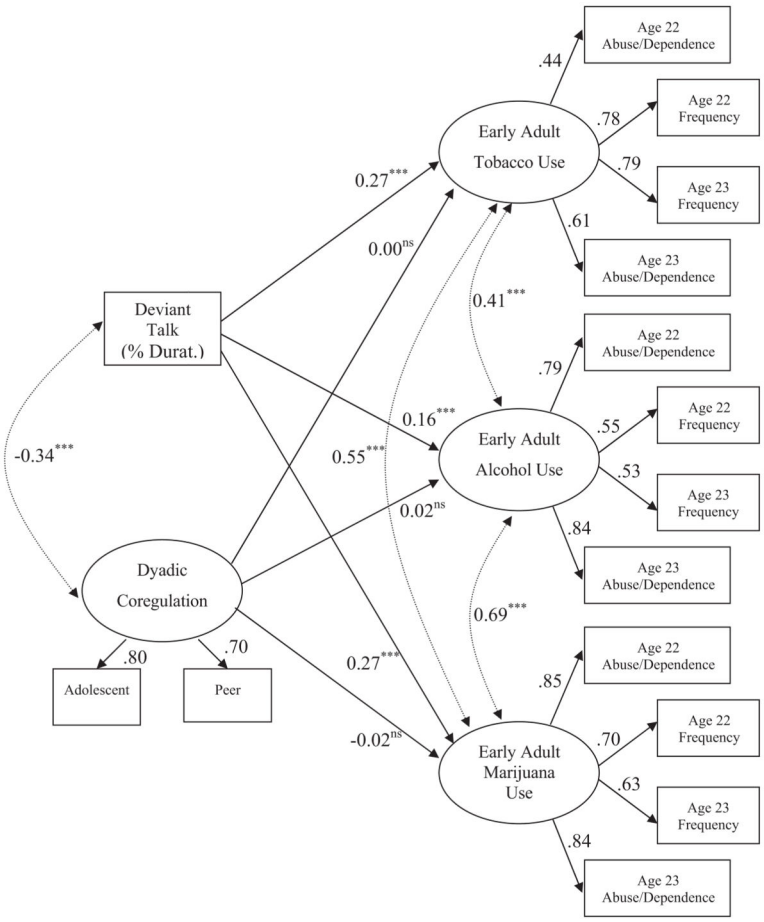

Figure 1.

A path model of percentage duration of deviant talk and dyadic coregulation during adolescence predicting problematic usage of tobacco, alcohol, and marijuana in early adulthood. Standardized values are reported. The loadings of all factor indicators are significant at $p < .001$. ^{ns} $p > .05$. *** $p < .001$. Durat. = duration.

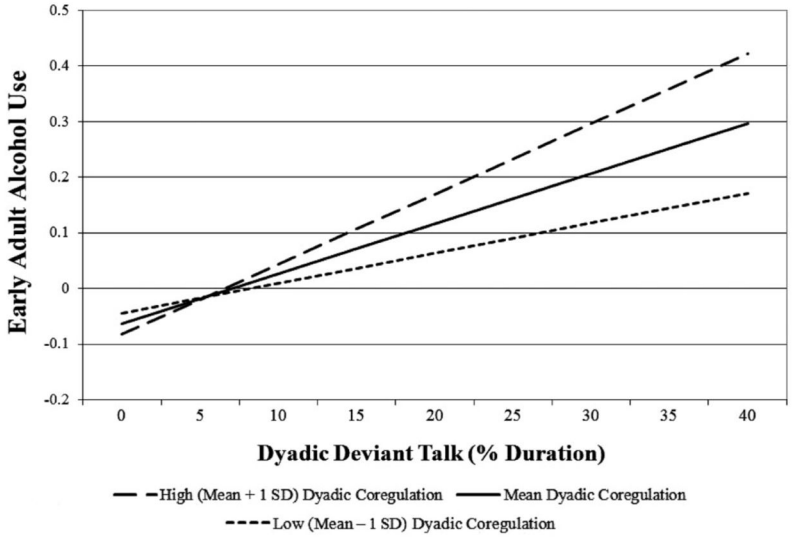

Figure 2.

The interaction between percentage duration of deviant talk and dyadic coregulation in predicting problematic early adulthood alcohol use.

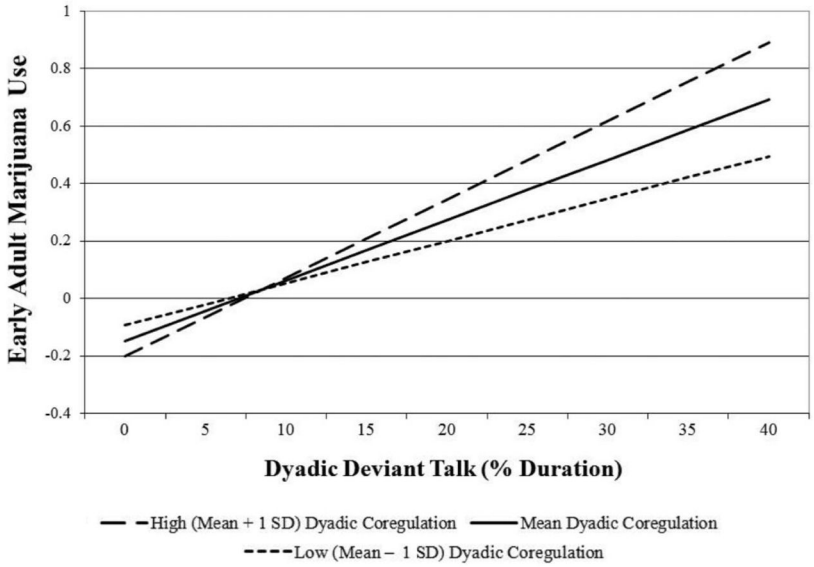

Figure 3.

The interaction between percentage duration of deviant talk and dyadic coregulation in predicting problematic early adulthood marijuana use.

Table 1

Descriptive Statistics and Correlations Among Measures for Substance Use Path Models (N = 711)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Adolescent regulation score	—														
2. Peer regulation score	.56	—													
3. Dyadic deviant talk	−.27	−.24	—												
4. Tobacco frequency age 22	−.10*	−.08ns	.23	—											
5. Tobacco frequency age 23	−.06ns	−.07ns	.22	.81	—										
6. Tobacco sx age 22	.00ns	−.07ns	.09*	.40	.36	—									
7. Tobacco sx age 23	.02ns	−.01ns	.15	.52	.55	.37	—								
8. Alcohol frequency age 22	−.06ns	−.05ns	.10**	.25	.21	.18	.09*	—							
9. Alcohol frequency age 23	.04ns	−.01ns	.05ns	.20	.26	.12**	.11**	.61	—						
10. Alcohol sx age 22	−.03ns	−.03ns	.15	.26	.23	.26	.16	.42	.35	—					
11. Alcohol sx age 23	−.05ns	−.05ns	.15	.26	.22	.22	.23	.45	.43	.60	—				
12. Marijuana frequency age 22	−.12**	−.05ns	.24	.35	.30	.15	.22	.38	.30	.34	.32	—			
13. Marijuana frequency age 23	−.05ns	−.03ns	.18	.28	.32	.11**	.20	.35	.38	.30	.33	.75	—		
14. Marijuana sx age 22	−.09*	−.04ns	.23	.30	.33	.25	.29	.29	.24	.51	.42	.59	.50	—	
15. Marijuana sx age 23	−.07ns	−.05ns	.23	.32	.32	.23	.31	.27	.23	.40	.50	.56	.52	.75	—
M	1.62	1.77	7.33	2.36	2.35	.25	.20	3.16	3.21	1.34	1.42	1.57	1.43	1.19	1.18
SD	1.20	1.17	9.38	3.02	3.04	.43	.40	2.13	2.18	1.09	1.07	2.50	2.43	1.33	1.29

Note. sx = symptoms of abuse/dependence. All correlations are significant at $p < .001$, except when otherwise specified.

ns $p > .05$.

* $p < .05$.

** $p < .01$.