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Depressed Mood and Drinking Occasions across High School: Comparing the Reciprocal Causal Structures of a Panel of Boys and Girls

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Abstract

Does adolescent depressed mood portend increased or decreased drinking? Is frequent drinking positively or negatively associated with emotional well-being? Do the dynamic relations between depression and drinking differ by gender? Using block-recursive structural equation models, we explore the reciprocal short-term effects (within time, t) and the cross-lagged medium-term effects ($t+1$ year) and long-term effects ($t+2$ years) of depressed mood and monthly drinking occasions. Data come from the high school waves of the Youth Development Study, a randomly selected panel of 1,015 ninth graders followed to 12th grade. We found that for both genders, depressed mood consistently *decreased* short-term drinking in each grade measured. However, depression *increased* drinking for both genders in the medium-term but only for girls in the long-term. In the other direction, drinking tended to increase depression in the short-term only among ninth-grade boys and 12th-grade girls. Observed trends and differences in the magnitude of the reciprocal effects vary by gender, with drinking being especially deleterious to emotional well-being for boys early in high school (10th grade) but for girls on the cusp of the post-high school world (12th grade).

Given longstanding interest in the association between social and psychological well-being and behavior among adolescents (e.g., Crosnoe, 2006; Kandel, Treiman, Faust, & Single, 1976; Stewart & Power, 2003), it is surprising that investigations of the causal relationships between psychological and behavioral problems are often treated in relative isolation to each other. One orientation emphasizes how affect and well-being are influenced by social behavior (e.g., delinquency, academic achievement) or social structural factors such as gender, race, and class (e.g., Ge, Elder, Regnerus, & Cox, 2001; McLeod & Owens, 2004; Robbins & Martin, 1993). The other orientation accentuates the causal effects of stress and other psycho-emotional troubles on such behaviors as substance use and school activity (e.g., Aseltine & Gore, 2000; Gil et al., 2003). Although both approaches are valid and important, too little research draws on both perspectives *simultaneously*.

This paper seeks to address that shortcoming by uniting two perspectives on youth problems into a single, block-recursive model¹ estimating the proximal, intertwined effects that a significant adolescent health risk and delinquent behavior—number of drinking occasions—and a central aspect of emotional well-being—depressed mood—have on each other. The

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theoretical underpinning of our study, detailed later, derives from a combination of perspectives regarding the potential push-and-pull relationships between depressed mood and drinking, and how these vary by gender (a key demographic and developmental characteristic in its own right).

Our central analytic foci—depressed mood and drinking—are vital topics of study for the adolescent life course. Everyone experiences depressed mood at various points in their lives; it falls within the range of normal though unwelcome human mood states (e.g., Compas, Ey, & Grant, 1993). Depressed mood is a key predictor of referral for psychological counseling (Holsen, Kraft, & Vittersø, 2000); it may stem from a variety of environmental and internal stimuli, be associated with assorted behavioral or emotional correlates, and last varying lengths of time. Patterns of occurrence vary especially by gender. Estimates of adolescent girls reporting symptoms of depressed mood in a given six-month period range from 25 to 40 percent (Compas et al., 1993, p. 325), while boys' rates vary from 11 to 35 percent depending upon the study (Compas et al., 1993, p. 25; Hankin et al., 1998). This difference is not surprising: typically, girls are more vulnerable to internalizing problems such as depression and anxiety (Rosenfield et al., 2000), partially because they are socialized more for self-regulation and may be more sensitive to negative external feedback (e.g., Colten & Gore, 1991; Eder, 1995).

Similarly, alcohol use is also an important social and public health concern. Approximately 10.7 million American teenagers currently drink alcohol at least monthly (U.S. House of Representatives Committee on Education and the Workforce, 2004). Alcohol is also a major factor in motor vehicle accidents, homicides, and suicides—the three leading causes of death among American teenagers (Hoyert et al., 2001, pp. 29–30). The vast majority of teenage drinking involves peer influence and group settings (Sieving, Perry, & Williams, 2000; Windle, 1999). Windle notes that the term *peer pressure* misses the character of adolescent drinking; it is more an aspect of peer selection based on common interests and activities and reciprocal socialization (1999; see also Reed & Rountree, 1997).

Drinking means different things to different teens—and their parents. For some it is an alarming and deviant behavior that can rend network connections, such as frequently drinking to excess or alone. To other teens, it can actually help build network connections and provide a sense of participation in what Habermas (1989) calls the public sphere. Here, drinking in a group can evoke a perception that one is cultivating and experiencing inclusiveness and egalitarianism with peers. Of course, drinking parties can also be a source of stress and confusion as the teen deals with friendships and acquaintanceships that have come and gone, and comes face-to-face with romantic attractions and entanglements.

Like depressed mood, alcohol use varies by gender. Although roughly half of all 12th graders drink at least monthly, boys are about 10% more likely to do so (Johnston, O'Malley, Bachman, & Schulenberg 2003). According to Leadbeater, Kuperminc, Blatt, & Herzog (1999), boys are at higher risk for externalizing problems—through behaviors such as substance use—because male socialization tends to focus more on self-assertion while underemphasizing self-regulation (Leadbeater et al., 1999). Research also suggests that girls experience greater stigma for using alcohol than do boys (Locke & Newcomb, 2001; Robbins & Martin, 1993). If stigma can be viewed as an assault on the self (Goffman, 1963), it may also be a progenitor of depressed mood. Thus, alcohol use may be especially problematic for girls' emotional well-being.

¹Block-recursive models combine recursive models (where causal influences are assumed to work in one direction only) with nonrecursive models (which allow two-way causation or feedback loops). Specifically, and in our case, relations *within* blocks (i.e., time-periods or grades in high school) are nonrecursive or two-way, while the relations *between* blocks (i.e., across-time) are recursive or one-way.

Although there is little doubt that alcohol use and psychological distress can have serious consequences for adolescents, little is known about the *reciprocal* relationship of drinking and emotional well-being among teenagers in the general population. Furthermore, while there is abundant evidence that patterns of drinking and depressed mood differ among girls and boys (e.g., Hallfors, Waller, Bauer, Ford, & Halpern, 2005; Locke & Newcomb, 2001), there is a relative shortage of prospective research on reciprocal causal structures of depressed mood and alcohol use, and especially by gender. Given the interest that policymakers, foundations, parents, and educators have in the twin issues, it is astonishing that so little has been done to establish what, if any, reciprocal causality exists between them and what their relative strengths may be.

Our interest in reciprocal causal structures is partly responsive to Blalock's (1989) plea for more realistic and dynamic models that incorporate feedback loops. While economists have long used nonrecursive models in their research, they remain fairly rare in adolescent research (for important exceptions, see Hoffmann & Su, 1998; Rosenberg, Schooler, & Schoenbach, 1989; Rosenberg, Schooler, Schoenbach, & Rosenberg, 1995). The present study seeks to utilize the strengths of reciprocal causal models—and their possibility for advancing understanding of complex social relationships—to explore the mutual causality of emotional distress and substance use within a key status dimension: gender.

THEORY: THE DEPRESSION-DRINKING NEXUS

Theories on the relationship between emotional and psychological well-being and alcohol use tend to revolve around two broad perspectives. The first emphasizes coping with psychological or emotional distress through drinking (i.e., catalyst—or what we call “push” explanations). The second orientation revolves around drinking as a more recreational or pro-social activity perhaps attuned to the public sphere (i.e., attraction—or what we call “pull” explanations).

Concerning *push explanations* that may hasten some people to use alcohol (e.g., Hartka et al., 1991; Repetto, Zimmerman, & Caldwell, 2004), two intertwined motivations are worth noting here: self-medication and self-adjustment. With respect to the first motive, distress in the form of fear, anger, anxiety, sadness or depression may constitute a more immediate, short-term motivation to drink as a way of handling the blues or unease (e.g., Cooper, Frone, Russell, & Mudar, 1995; Mohr et al., 2001; Repetto et al., 2004). For instance, Hussong, Hicks, Levy, and Curran (2001) examined the “tension reduction hypothesis” wherein distress and negative mood prompt alcohol use in order to regulate affect. They found that only two dimensions of distress (hostility and sadness) were related to short-term drinking. Moreover, for adolescents with less supportive and intimate peer friendships, drinking tended to increase sadness, and vice versa. Relatedly, Mohr et al. (2001) found support for a motivation model linking daily drinking to context-dependent drinking behavior. On days when their non-alcoholic adult subjects had more negative interpersonal experiences they engaged in more solitary drinking, while more positive interpersonal experiences resulted in more social drinking with others (p. 496).

However, for others the self-medication hypothesis is nuanced, especially over longer time intervals. For example, Hallfors et al. (2005) found that over one year, girls who experimented with alcohol were two times more likely than abstaining girls to be depressed. Conversely, binge-drinking boys were four times more likely than abstaining boys to report depression.

The self-adjustment motive, while similar to self-medication, looks at longer-term links (ranging from several months or more) between distress and coping behaviors. For adolescents, these may include stepping up one's social activities, such as trying to see one's friends more often, joining a club, or getting a job (e.g., Hauser & Bowlds, 1990; Mortimer, 2003). It also entails drinking as a shared activity within the public sphere (Habermas, 1989), including

partying with other teens (e.g., Windle, 1999). For example, Crosnoe (2006) noted that the number of classes a high school student failed predicted alcohol use one year later. This pattern is not without complexity; Aseltine and Gore (2000) found that stress becomes weaker at predicting drinking as adolescents move toward young adulthood (2000). Hartka et al.'s (1991) meta-analysis of eight adult general population studies is instructive. They found that depression positively predicted drinking *quantity* only over very long term intervals (3–10 years), while drinking's positive effect on depression was limited to shorter intervals (2 years), especially for females (p. 1294). Aneshensel and Huba's (1983) longitudinal community study of adults showed that the measurement interval is important in understanding the relationship between depression and drinking. They found that depression had a slight positive effect on alcohol use over a short-term interval (4-months). Conversely, alcohol use had a small positive effect on depression over a medium-range interval (12-months) (p. 146).

Pull orientations see adolescent drinking not so much a function of distress but rather as a potentially attractive and available fun or positive activity. Two motives within this orientation are worth noting here. First, the *hedonic motive* views drinking as a way of enhancing pleasure in general or as a way of enhancing a positive mood state in particular (Gendolla, 2000). In this sense, the "directive mood impact on behavior" is emphasized (Gendolla, 2000). Second, employing an *adult modeling motive*, teen drinking can be viewed as a form of anticipatory socialization on one hand or as a precocious claim on adulthood on the other (e.g., Krohn, Lizotte, & Perez, 1997; McMorris & Uggen, 2000). Here, the predicate motivation is to express adult behavior and to exercise the heightened freedoms and stature it presumably engenders. After all, as Chassin, Pitts, and Delucia (1999) note, different forms of drinking "may be more normative and less maladaptive in adulthood... than in adolescence" (p. 930).

Gender

Three perspectives on the role that gender may play in the relationship between psychological well-being and drinking are useful for our purposes (see Robbins, 1989). They are the styles of deviance perspective, the generalized female vulnerability perspective, and the convergence/liberation hypothesis. According to the *styles of deviance perspective*, internalizing problems are more common for females while externalizing problems are more common for males (see also Rosenfield et al., 2000). Females, who tend to engage in deviance in more furtive and limited ways, may face greater distress when they do engage in more visible deviance. In particular, female drinking tends to have a greater impact on their susceptibility to intrapsychic distress such as depression and sadness. Robbins and Martin (1993) note that uncontrolled drinking (e.g., "tossed down several drinks pretty fast to get a quicker effect," p. 309) had a stronger positive association with depression for girls than boys. For males, substance use was associated with greater behavioral and interpersonal problems such as being belligerent. Among those told by significant others to reduce their drinking, the association with depression was positive for girls but negative for boys (Robbins & Martin, 1993).

The *generalized female vulnerability perspective*, which claims that females tend to be more adversely affected by increased substance use than males, subsumes three sub-perspectives. First, women and girls are more physically susceptible to the negative effects of alcohol than are men. For instance, alcohol is a chemical depressant that typically reaches females' blood streams quicker and in higher concentrations than in males' (Parrott, Morinan, Moss, & Scholey, 2004), thus potentially causing them more problems. Second, and irrespective of the susceptibility issue, we have already noted that females are often stigmatized much more for simple intoxication (let alone drunkenness or alcoholism) than males are (e.g., Locke & Newcomb 2001). And the literature consistently shows that labels and stigma matter for psychological well-being and distress (e.g., Downs & Rose, 1991; Goffman 1963; Link & Phelan, 2001). A third perspective, which closely parallels the second, sees the violation of

internalized gender norms as increasing distress more for females who drink frequently or to excess than for males. A corollary is that gender differences in the influence of adolescent drinking on depression may also result in heightened parental monitoring of, and the imposition of more restrictions on, imbibing adolescent girls (cf. Robbins & Martin, 1993). This suggests that girls may have more motivation than boys to sip rather than chug alcohol, which also parallels the styles of deviance perspective. It also includes a general tendency for parents and peers to be quicker to negatively label girls who commit even minor acts of deviance, including frequent drinking (see Bartusch & Matsueda, 1996; Svensson, 2003). Findings by Hallfors et al. (2005) suggest that girls may also have greater interpersonal sensitivity, which can increase their vulnerability to stigmatization.

Finally, Adler's (1975) *convergence/liberation hypothesis* tends to run counter to the first two perspectives. Adler claims that deviance and delinquency rates among female and male adolescents are converging. Moreover, if a general relaxing of traditional female gender norms over the past few decades has freed girls to act out more, then frequent drinking may not carry the same stigma for the current generation of girls as it did for past generations. The result is that differences in deviance among younger cohorts of females and males, including frequent alcohol use, could be either quite small or nonexistent (Robbins, 1989).

Hypotheses

We turn first to the longer-term (cross-lagged) effects of depressed mood on drinking. As the self-adjustment motive would suggest, negative affect (especially depression and sadness) may predict greater coping motives and subsequent drinking over medium (i.e., contiguous) and longer (i.e., distal) time intervals. We thus expect all cross-lagged effects of depression on drinking to be positive (**H₁**).

Our primary interest, however, is on reciprocal effects, especially by gender. First, because alcohol is a central nervous system depressant that is sometimes also used as a form of self-medication among people in emotional doldrums, some may expect drinking and feeling blue to form a positive or reinforcing cycle. However, existing literature pointing to the pleasure-seeking (Gendolla, 2000) and often-social (Sieving et al., 2000; Windle, 1999) motivations for teen drinking leads us to expect otherwise. Instead, and also in light of the earlier theory discussion, we believe they will be countervailing influences (**H₂**). Specifically, we expect the proximal (i.e., short-term) effect of depression on drinking to be negative (**H_{2a}**) and for the effect of drinking on depression to be positive (**H_{2b}**). The proximal effect of depression on drinking comports with the pull orientation, while the proximal effect of drinking on depression comports with the notion of alcohol as a depressant and potential source of stigma outlined earlier. Second, because alcohol can be a stressor in its own right and possibly lead to a variety of personal and social difficulties, especially for girls, we expect the proximal impact of drinking on depression to be stronger for girls than for boys (**H₃**). This expectation, while counter to the convergence/liberation hypothesis, follows the generalized female vulnerability and the styles of deviance perspectives; girls who run counter to the gender norm of the "good girl," for instance, risk the stress of being corrected by a significant other and being negatively labeled.

DATA AND METHODS

Sample

The data come from the high school waves (grades nine-12) of the Youth Development Study, a prospective longitudinal panel study of 1,139 adolescents and their parents. The sample was chosen randomly from a list of all ninth-graders enrolled in the St. Paul (Minnesota) School District at the time of the initial data collection (winter 1988) and who had no disabilities that

prevented them from completing a questionnaire. (Since the vast majority of subjects were born within the same 12-month period, age and grade are nearly equivalent.) St. Paul is a city with a 1990 population of 272,000 within a metropolitan area of 2.5 million (U.S. Bureau of the Census, 1997, pp. 42, 47). During each wave of data collection, the teenagers completed pencil-and-paper questionnaires administered in school. Those absent or who subsequently moved away or dropped out of school responded by mail. By Wave 4 (12th-grade) a mere 7 percent of subjects had attrited; and, there is little difference between stayers and leavers (Staff, 2004).

Slightly less than two-thirds (63.3%) of students identified themselves as white, while 8.6 percent identified as black or African American, 4 percent as Hispanic, 10.9 percent as Southeast Asian, 1.5 percent other Asian, 0.8 percent Native American, and 6.2 percent as multiracial or other. Since many of the Southeast Asians were recently arrived Hmong, originally from Cambodia and Laos and who had been preliterate horticulturists only a few years or months prior to the beginning of the study, language and cultural differences make them quite distinct from their non-Southeast Asian peers. Consequently, the Hmong are not included in these analyses. The effective sample size (excluding the Hmong and the 7 percent who attrited by 12th grade) is 1,015, of which 52.6 percent are girls and 47.4 percent are boys.

Measures

Endogenous and exogenous variables—The variables of primary concern are the number of times alcohol was consumed in the preceding month (i.e., drinking occasions) and depressed mood (see Table 1 for descriptive data). Drinking occasions was captured with the question, “How many times have you had alcoholic beverages to drink in the past 30 days?” Responses ranged from 0=none to 6=40 or more. The 30-day prevalence measure is a widely used benchmark in alcohol research (e.g., Bachman, Wadsworth, O’Malley, Johnston, & Schulenberg, 1997; Foster, Vaughn, Foster, & Califano, 2003; Windle, 1999). Measuring drinking occasions in the last thirty days also allows proximal measurement to account for recent health behavior’s influence on current emotional well-being, and vice versa. In order to compensate for kurtosis, we added 1 as a constant and then took drinking occasions’ natural logarithm.

Depressed mood is measured with four items from the Health Insurance Study Mental Health Battery (Ware, Johnston, Davies-Avery, & Brook, 1979). These items are consistent with other scales used to measure adolescent depressed mood (e.g., Costello & Angold, 1988). The teens were asked “During the past month, how much of the time” have you felt downhearted and blue, felt depressed, been moody and brooded about things, and been in low or very low spirits. Response options ranged from 1=no time to 5=all of the time. It is important to note that our scale, like many in social psychological research, is not a clinical intake evaluation of depression per se. Instead, it is a general measure of depressed mood/depressive affect, a common though unpleasant mood state.

We assessed depressed mood’s measurement structure with confirmatory factor analysis using AMOS 6 (Arbuckle, 2005). Assessment of fit helps determine whether a given theoretical model adequately describes the pattern of relationships within a given set of data. The model, which includes correlated error terms of the same items between contiguous periods, fits the data well. The ratio of χ^2 (114.99) to degrees of freedom (86) is 1.34, the comparative fit index (CFI) is a high .99, the normed fit index (NFI) is a high .97, the incremental fit index (IFI) is a high .99, and the root mean square error of approximation (RMSEA) is a low .03. See Browne and Cudeck (1993) and Hu and Bentler (1999) for a discussion of the use and interpretation of the fit indices. In addition, and as a prelude to the gender comparisons, a multigroup depressed mood confirmatory factor analysis of boys’ and girls’ across all four waves of data showed it is structurally invariant. Specifically, no statistical difference in the χ^2 -to-degrees of freedoms

exist ($p < .36$) between the constrained model forcing gender equivalence (477.8 and 194, respectively) and the unconstrained model (490.9 and 206, respectively).

Controls/Moderators—Two controls are used: family socioeconomic status (parents' self-reported education and annual income when the subjects were in the ninth grade) and race (whites versus all others). Gender acts as a moderator via multigroup modeling discussed later.

Analytic Strategy

We pose a block-recursive structural equation (path) model of number of drinking occasions and depressed mood for boys and girls across all four years of high school. (To simplify, we will henceforth refer to drinking occasions as “drinking” and depressed mood as “depression.”). Of particular interest are the three nonrecursive blocks (A–C) associated with grades 10, 11, and 12, respectively (see Figure 1). Each block specifies a feedback loop among proximal drinking and depression for a given time period.

The model starts with race/ethnicity and SES controlled on grade 10–12 drinking and depression endogenous variables. Next, exogenous ninth-grade depression and drinking variables are allowed to covary (parameter a in Figures 1 and 2). In addition, the model allows disturbance terms to covary within-time blocks (e.g., $\zeta_1 \zeta_4$) but not across blocks.

Parameters b_k and c_k are the stability coefficients for depression and drinking occasion, respectively, at a particular time (k). They represent the relative change or stability in the same variable over time. Next, there are five cross-lagged variables signifying contiguous and distal effects of depression on drinking. Since coping theories of emotional distress and substance use would lead one to expect depression to precede drinking for most middle adolescents, at least initially, and for emotion to have a longer effect on behavior than the reverse, we specify lagged causal effects of depression on drinking. Parameter f_k represents the contiguous influence of depression at time t on drinking at $t+1$ while g_k represents the longer influence of depression at t on drinking at $t+2$. Finally, and most importantly, we specify three sets of reciprocal effects in grades 10–12 (i.e., blocks A–C). The proximal feedback loops are represented by parameter d_k (e.g., $DO-10 \rightarrow DM-10$) and parameter e_k (e.g., $DM-10 \rightarrow DO-10$), where DO refers to drinking occasions and DM refers to depressed mood.

The stability effects of depression (b_k) and drinking (c_k) are hypothesized to be moderately positive and statistically significant from one grade to the next. That is, prior depression (or drinking) will positively influence the level of depression the following year. Since adolescence is a time of experimentation, finding oneself, and personal development, we would expect drinking and depression to be somewhat fluid for boys and girls alike in the high school years. Finally, longer stability effects are not specified since the preponderance of influence is hypothesized to be contiguous, or from the period immediately preceding it.

Model Identification

The problem of underidentification is especially troublesome in nonrecursive modeling. We address that issue now. Our four-wave, two-variable block-recursive model can be viewed generally as a system of six linear structural equations for the variables depression mod (DM_{ik}) and drinking (DO_{ik}), and the error term (ζ_{ik}), which represents deviation from the predicted level of DO or DM for child i at time k . The equations for depression, excluding the controls in order to expedite the presentation, are:

$$DM_{10} = b_1 DM_9 + e_1 DM_{10} + \zeta_1 \quad (1a)$$

$$DM_{11}=b_2DM_{10}+e_2DO_{11}+\zeta_2 \quad (1b)$$

$$DM_{12}=b_3DM_{11}+e_3DO_{12}+\zeta_3 \quad (1c)$$

The equations for drinking are:

$$DO_{10}=c_1DO_9+d_1DM_{10}+f_1DM_9+\zeta_4 \quad (2a)$$

$$DO_{11}=c_2DO_{10}+d_2DM_{11}+f_2DM_{10}+g_1DM_9+\zeta_5 \quad (2b)$$

$$DO_{12}=c_3DO_{11}+d_3DM_{12}+f_3DM_{11}+g_2DM_{10}+\zeta_6 \quad (2c)$$

A model can be said to be identified if there is a unique solution for each of its parameters and the unknown parameters are only functions of the identified parameters (Bollen 1989, p. 88). Put differently, in order for our block-recursive model with three feedback loops to be identified, the number of normal equations for each block must be greater than or equal to the number of parameters to be estimated (Greenberg & Kessler, 1982; Thornberry & Christenson, 1984). This is accomplished by employing two instrumental variables (the exogenous DM-9 and DO-9) to construct six normal equations. The six parameters (b_{ik} and e_{ik}) in the depression equations (1a – 1c) can be uniquely estimated with the model's six normal equations and the instruments DO-9 and DM-9 (see Figure 1). As initially specified, however, the drinking equations (2a – 2c) do not contain enough information to uniquely solve each equation because the 11 parameters to be estimated (c_{ik} , d_{ik} , f_{ik} , and g_{ik}) exceeds the six normal equations available to estimate them. To make estimation possible, five or more constraints must be imposed across the three blocks.

Briefly, three types of constraints can be employed, with two being more restrictive and one being less restrictive. We could fix specific parameters to some nonzero number (provided theory is sufficiently advanced to warrant such detail) or fix them to zero (which hypothesizes that no relationship exists). Both constraints engender more theoretical restrictions than we are willing to assume. Instead, we take the less restrictive alternative of employing five reasonable equality constraints across the three nonrecursive blocks (Thornberry & Christenson, 1984).

² The constraints and their respective blocks are:

- $c_3 = c_2$ (Blocks C and B)
- $d_2 = d_1$ (Blocks B and A)
- $g_2 = g_1$ (Blocks C and B)
- $f_3 = f_2 = f_1$ (Blocks C, B, and A)

²Specifically, Greenberg & Kessler (1982) and Thornberry & Christenson (1984) advocate making the assumption that two or more parameters of the same type may be constrained to be equal (i.e., the parameter values are consistent). Consequently, we have placed these constraints: $c_3=c_2$ (stability coefficients for drinking occasion), $d_2=d_1$ (within-block coefficients estimating DO), $f_3=f_2=f_1$ (t+1 coefficients estimating DO), and $g_2=g_1$ (t+2 coefficients estimating DO).

RESULTS

The fit statistics and stability coefficients for the full and the gender-differentiated models are similar (see Figures 1 and 2, respectively). Specifically, the fit statistics show that the theoretical models fit the observed data reasonably well. The CFIs, NFIs, and IFIs are all above .90, as desired, while their RMSEAs are a low .09 to .06 respectively. As hypothesized, the stability coefficients of both depression (parameters b_{1-3}) and frequency of monthly drinking (parameters c_{1-3}) in the two models are moderately stable from one grade—or developmental period—to the next. For example, in the full model (Figure 1), teens who scored high (or low) on the depression index in 10th grade, in relation to their peers, tended to retain their same relative positions in 11th grade (e.g., $\beta = .47$, $p < .05$; parameter b_2). Our stability findings comport with other longitudinal assessments of adolescent depression (e.g., Rosenberg et al., 1989) and drinking (e.g., Bachman et al., 1997).

Full Sample

Figure 1 shows our substantive findings in path-analytic form for the whole sample (standardized β -coefficients and significances). To start, neither of the longer-term—distal—cross-lagged effects of depression on drinking were significant ($t+2$, parameters g_{1-2}). This runs counter to part of Hypothesis 1. A two-year lag dissipated any influence that prior depression may have had on subsequent drinking. This is not entirely unexpected; Hartka et al. (1991) found that the impact of depression on drinking is generally more consistent over shorter time intervals. True to form, Hypothesis 1 is supported in the contiguous (medium-term) cross-lagged effects ($t+1$, parameters f_{1-3}), which were all modestly positive and significant. The influence of DM-9 on DO-10 is .18 ($p < .05$), that of DM-10 on DO-11 is .18 ($p < .05$), and that of DM-11 on DO-12 is .19 ($p < .05$). These findings also comport with other studies (e.g., Gilman & Abraham, 2001).

Recalling that our central thesis is that adolescent depression and drinking are reciprocally related and that neither can be viewed entirely as a cause or an effect of the other, we turn now to the within-month—proximal—reciprocal influences between depression and drinking. In support of Hypothesis 2_a, the influence of depression on drinking was significant and moderately negative in each grade measured (parameters e_{1-3}): 10th ($\beta = -.32$, $p < .05$), 11th ($\beta = -.29$, $p < .05$), and 12th ($\beta = -.39$, $p < .05$). Our data thus suggests that depression had a suppressing effect on drinking in the short-run, after prior depression and drinking were controlled (as Hartka et al., 1991, partly suggest). This difference from the earlier positive contiguous ($t+1$) cross-lagged effects is noteworthy and will be discussed more in the Discussion.

In the other direction, the proximal effect of drinking on depression offered moderate though partial support for Hypothesis 2_b. Although the 11th grade parameter (d_2) is not significant, the other two grades' coefficients are modestly positive and significant, as predicted. The influence of DO-10 on DM-10 is $\beta = .12$ ($p < .05$) and the influence of DO-12 on DM-12 is $\beta = .14$ ($p < .05$) (parameters d_1 and d_3 , respectively). Taken together, general Hypothesis 2 (the expectation that depression and drinking will have countervailing influences on each other) is supported in 10th grade (block A) and 12th grade (block C).³

Finally, even though the paper's focus is on gender differences, because race/ethnicity and socioeconomic status have been linked elsewhere to drinking and depression (e.g., Gore & Aseltine, 2003; Stewart & Power, 2003) we ran separate multigroup models for race/ethnicity and SES. (See explanation of multigroup analyses below.) Only one parameter differentiated

³Modeling nonlinearity within a SEM format can be problematic so we assessed it via a series of regression analyses; no quadratic variables were significant.

the two race/ethnic groups. The distal effect of DM-9 on DO-11 (t+2, parameter g_1) was significant only for nonwhites ($\beta = .18, p < .05$). Moreover, this racial/ethnic difference only approached conventional statistical significance ($p < .10$). However, dividing the sample into high, middle, and low SES tertiles revealed no significant differences in any parameter estimates.

Gender-Differentiated Sample

The standardized gender findings are reported in Figure 2. To make efficient comparisons, the boys' coefficients are bolded and the girls' are underlined. Statistically significant gender differences, if any, are denoted with a rectangle ($\square$) around the compared parameters.

When assessing if a particular parameter's magnitude is significantly different between boys and girls, we use multigroup ("stacked") model analyses. For example, when, in a stacked model with both groups estimated simultaneously, a parameter of interest (c) is constrained to be equal across groups is compared to a freely estimated model with no such constraint (f), the probability of the difference (d) is:

$$\frac{\chi_c^2 - \chi_f^2}{df_c - df_f} = \frac{\chi_d^2}{df_d}. \quad (3)$$

A significant χ_d^2 indicates that a statistically significant difference exists between boys and girls for the parameter of interest.

Turning first to the distal cross-lagged effects (t+2 years, parameters g_{1-2}), they are significant and modestly positive for girls only: DM-9 to DO-11 is $\beta = .10$ ($p < .05$) and DM-10 to DO-12 is $\beta = .11$ ($p < .05$). While these findings only partially support Hypothesis 1, it is worth remembering that neither path was significant in the gender-undifferentiated model above. However, the contiguous effects (t+1 year, parameters f_{1-3}) are modestly positive and significant for both genders across all three time-spans. They range from $\beta = .19$ ($p < .05$) for boys in parameter f_1 to $\beta = .22$ ($p < .05$) for girls in parameter f_3 . Nonetheless, no statistically significant gender differences were observed.⁴

Concerning the reciprocal effects paths (blocks A–C), depression has a significantly moderate to strong negative impact on concurrent drinking in all grades and for both genders (parameters e_{1-3}). This is solid confirmation of Hypothesis 2a. And even though there are gender differences, they are not wholly consistent. While the parameters' signs are the same across genders and grades, the coefficients' magnitudes are not. For boys, the negative effect of depression on drinking is strong in 10th grade ($\beta = -.48, p < .05$) and moderate in 11th grade ($\beta = -.27, p < .05$) and 12th grade ($\beta = -.30, p < .05$). The trend is the opposite for girls. For them, the negative effect of depression on drinking starts moderate in 10th ($\beta = -.24, p < .05$) and 11th grade ($\beta = -.32, p < .05$) and becomes quite strong in 12th grade ($\beta = -.53, p < .05$). (The magnitude of the changes from 10th to 12th grade are significant at $p < .05$ for both genders.) Regarding within-grade gender differences, the negative influence of DM-10 on DO-10 is

⁴An alternative block-recursive model was also specified, wherein the distal and contiguous cross-lagged effects of drinking on depression were estimated. (A block-recursive model incorporating cross-lagged paths from drinking to depression and from depression to drinking cannot be identified and is therefore not estimable.) The new estimates are consistent with those found in the original full-sample model (Figure 1) but differed from the original gender-differentiated model (Figure 2). Concerning the latter, the contiguous effects of drinking on depression were significant ($p < .05$) and modestly positive for boys and girls in all three paths (DO-9 to DM-10 is .21 for boys and .19 for girls, while DO-10 to DM-11 and DO-11 to DM-12 are .19 for both genders). Unlike the original model, however, the distal effects of drinking on depression two-years hence were not statistically significant for either gender (DO-9 to DM-11 and DO-10 to DM-12 are $-.07$ for boys and $.04$ for girls). The effect of adolescent drinking on depressed mood is clearly limited to the short- and the medium-term.

significantly more negative for boys ($p < .05$, parameter e_1), while in 11th grade no significant gender difference is observed (parameter e_2). By 12th grade, however, the negative effect of depression on drinking was significantly stronger for girls than for their male peers (parameter e_3).

Turning to drinking's proximal effects on depression (parameters d_{1-3}), we find meager support for Hypothesis 2_b. Only two significant paths are observed: the boys' in 10th grade and the girls' in 12th grade. Specifically, drinking has a moderately positive impact on depression for 10th grade boys ($\beta = .33$, $p < .05$) but no discernable consequence for girls (parameter d_1). Contrary to Hypothesis 3, these gender differences are statistically significant ($p < .05$). In 11th grade, drinking has no impact on depression for either gender (parameter d_2). However, by 12th grade (parameter d_3), the relationship is significant and moderately positive for girls ($\beta = .29$, $p < .05$) but is not significant for boys, a reversal from 10th grade. Per Hypothesis 3, the 12th grade gender differences are significant ($p < .05$). Furthermore, the increase in the magnitude from 10th and 11th grades to 12th is significant only for girls ($p < .05$). When the girls were in 12th grade, the positive effect of drinking on depression was markedly stronger than before.

DISCUSSION

Although social psychologists have long been interested in the link between psychological well-being and behavior (and vice versa), the cause and effect relationships are often treated in comparative isolation. We addressed this shortcoming by joining two perspectives on youth problems into a block-recursive model estimating the short-term reciprocal effects of adolescent depressed mood and frequency of monthly drinking occasions. Medium- and long-term lagged effects of depression on drinking were also investigated. Our primary focus was on gender variations in affect and behavior over the high school years, a pivotal period of the life course.

We found fairly strong support for Hypothesis 1. In the full sample, depression had a significantly positive impact on drinking only in the medium-term (the contiguous $t+1$ paths). When gender was differentiated, significantly positive long-term (distal $t+2$) effects emerged only for girls, while the medium-term effects remained significant and positive for girls and boys alike. Overall, these results accord with the push orientation's self-adjustment motive (Windle, 1999). The group and often party atmosphere that typically accompanies teenage drinking might appeal to teenagers feeling down, especially as a medium-term strategy. These positive lagged effects extend to findings by Hartka et al. (1991) and Aneshensel and Huba (1983), both of whom used adult (over age 18) samples. Particularly, the more prolonged lagged effect of depression on drinking for girls (in the distal paths) has intriguing implications for the examination of self adjustment among girls over time. We suggest future research on this pattern.

The proximal (short-term, within-month) effects of depression on drinking revealed quite a different picture. As predicted in Hypothesis 2_a, the relationship was significantly *negative* in all three grades (10th–12th). This finding contradicts the push explanation's self-medication motive while suggesting aspects of the pull orientation. As depression *decreased*, drinking *increased*, as the hedonic motive would suggest (see Gendolla, 2000). The considerably stronger negative influence that depression had on drinking for 12th grade girls seems to contradict Adler's (1975) liberation hypothesis while hinting more at the styles of deviance perspective.

An alternative (yet compatible) view on the negative effect of depression on drinking is suggested in Rosenberg's low self-esteem theory (see Rosenberg & Owens, 2001). Low self-

esteem, a close correlate of depression, is often accompanied by feeling socially awkward, being hypersensitive to negative reflected appraisals, a desire for insularity, and a wish to avoid social risks. People in negative emotional mood states also tend to be less interested in social and leisure activities (e.g., Cunningham, 1988). Thus, drinking in groups may be less attractive to adolescents feeling downhearted or depressed. However, because we do not have the necessary data to test this supposition directly, we hope future research addresses it.

In the reverse direction, we found only partial support for Hypothesis 2_b (that the proximal effect of drinking on depression would be positive). Drinking only had a significant and positive effect on boys' depression in 10th grade, while it was only significant and positive for girls in 12th grade. In 11th grade, the relationship was not significant for either gender. This finding is especially noteworthy with respect to gender and developmental period. For instance, it highlights the special importance that 11th grade may have, especially for those considering college. Admissions officers typically rely heavily on junior year academic performance. (Approximately half of the YDS subjects went to college after high school [Mortimer, 2003, p. 186].) Although necessarily speculative here, this could mark 11th grade as an important "fork in the road" in the path toward young adult life.

Looking at the reciprocal effects for the full sample, and with gender taken directly into account, we found limited support for general Hypothesis 2 (that drinking and depression would have short-term countervailing influences on each other). Still, some of the reciprocal relations were striking. For instance, early in high school, the countervailing (cyclical) effect of depression and drinking appeared only for 10th grade boys (15–16 year-olds), but afterwards it disappeared, possibly because boys may be less careful or responsible in their early drinking than girls—i.e., when still relatively inexperienced, boys may be more apt to drink excessively high quantities per occasion (a possibility we could not explore with these data; however, see Robbins & Martin, 1993). For girls, however, the countervailing effect was absent until 12th grade (17–18 year-olds). These gender findings stand in contrast to Adler's convergence hypothesis, and are partly incompatible with a female vulnerability perspective (10th grade boys actually seemed more "vulnerable"). Rather, our findings imply a developmental trend, perhaps in line with the styles of deviance perspective. We cannot pinpoint the exact causes with these data. However, thinking further about the adult modeling motive might provide some clues.

As adolescents move through teen years, the contexts and symbolic character of alcohol—and perhaps more importantly, drinking—may come to mean different things to girls and boys. On the one hand, our findings support the overall concept of self-adjustment: teens may turn to drinking (over the medium-to-longer term) as a way of relieving tension and having fun in the especially taxing period of high school. Drinking can represent enjoyment, sociability, and integration, as well as a way of making a partial claim to adult status.

However, in the shorter term these may be precisely the things that make drinking (and groups) uninviting for more dysphoric boys and girls. Also, drinking can result in depressive mood because it is a chemical depressant, a potential stigma, a distraction from school, or possibly a way of isolating oneself (if drinking episodes are particularly heavy, or engaged in alone). Although the negative short-term effects influence mainly boys early on, they seemed to gain a hold on girls later in high school. This pattern signifies potential differences in the experience of being male or female, especially as related to drinking. As suggested by the styles of deviance perspective (and, in part, theories of female vulnerability), gender socialization is important (Howard & Hollander, 1997; Robbins, 1989). Based on non-biological female vulnerability principles, girls are at certain disadvantages based on overall stratification, as well as their roles and expectations, in dealing with drinking behaviors. Furthermore, and also suggested by the styles of deviance perspective, the potential stigmatizing and ostracizing effects of alcohol may

be particularly hard to bear for girls, who are often socialized into greater interpersonal sensitivity. This seems to be especially true as gender becomes more solidified in growing up. In 10th grade, drinking seems to cause more problems for boys. However, the significant change for boys and girls evident in the nonrecursive blocks moves progressively toward a problematic relationship between depression and drinking for girls as they reach 12th grade and young adulthood. For girls on the verge of leaving the relative restrictions of childhood for the new freedoms and risks of the adult world, one might expect frequent drinking to be particularly detrimental to girls' short-term emotional well-being.

Our study notably builds on the literature in four main ways. First, there is depression's negative effect on drinking for both genders at all grade levels. Hallfors et al. (2005) found a very limited similar effect, but only among certain girls. Second, we found greater vulnerability to alcohol among males than females in 10th grade. This is new; most studies discuss the greater vulnerability (from different causes) of girls. Third, the reversal trend in the reciprocal effects (boys' early vulnerability versus girls' late) partially expands Robbins and Martin's finding that sex differences in drinking behavior are smaller for adolescents than adults (1993); our findings suggest that these sex differences simply may be more *fluid* or in-flux among adolescents. Finally, our approach allowed us to explore, at each grade level, the age patterns between drinking and distress found by numerous authors (i.e., Aseltine & Gore, 2000; Chassin et al., 1999; Robbins & Martin, 1993).

Three study limitations are noted. First, although nearly one-third of the subjects were nonwhite, our sample size prevented in-depth examination of specific racial/ethnic differences in the drinking-depression nexus. A larger sample would have also allowed us to examine cross-status differences, such as black males, high SES girls, and so on. Second, our measure of drinking was limited number of drinking occasions. This, too, may underestimate the short-term reciprocal and longer-term crossed lagged effects of depression and drinking. Quantity drunk would also provide clearer indications of intoxication and binge or problem drinking on adolescent short- and long-term moods. Third, our data contained no information on attitudes toward drinking or on the particular settings—social or otherwise—in which the imbibing teens drank. Nor could we explicitly model stress. Future research on these issues is warranted.

These limitations aside, our analysis demonstrates the utility of applying block-recursive models to the study of developmental trends in behavior and social psychological attributes. While some information is necessarily lost, the analytic elegance of the block-recursive approach is evident in our results, especially by highlighting the relevance of an important status characteristic—gender—in understanding potential health risk behavior and psychological well-being during the mid- to late-adolescent years. They support continued exploration of the origins of these differences, and life course trends in psychological development.

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Figure 1. Full Sample Block-Recursive Model of Depressed Mood and Drinking Occasions (Grades 9 – 12)^a

^a (1) Parameter labels are at the arrowheads. (2) * $p < .05$. (3) CFI=.92; NFI=.91; IFI=.92; RMSEA=.09. (4) Correlated disturbances and SES and race/ethnicity controls not shown. Note: Because serial correlation of disturbance terms in block-recursive models is problematic and can result in the overestimation of stability effects and the underestimation of reciprocal effects (i.e., a possible increase in Type I error) (see Greenberg & Kessler, 1982; Thornberry & Christensen 1984), we do not estimate them in our final models.

Figure 2. Multigroup (Gender) Block-Recursive Model of Depressed Mood and Drinking Occasions (Grades 9 – 12)^a

^a (1) * $p < .05$. (2) Parameter labels are at the arrowheads. (3) **Bolded** coefficients represent boys; underlined represent girls. (4) Paired gender coefficients that are boxed are significantly different at $p < .05$. (5) CFI=.92; NFI=.90; IFI=.93; RMSEA=.06. (6) Correlated disturbances and SES and race/ethnicity controls not shown.

Note: Because serial correlation of disturbance terms in block-recursive models is problematic and can result in the overestimation of stability effects and the underestimation of reciprocal effects (i.e., a possible increase in Type I error) (see Greenberg & Kessler, 1982; Thornberry & Christensen 1984), we do not estimate them in our final models.

Table 1

Means and Standard Deviations for Model Variables and Sample/Subsample Sizes

Variable	Grade	Sample Origin			Mean Difference (One-Way ANOVA) by Gender (p < .05)
		All	Boys	Girls	
Monthly Drinking Occasion Range: 0 to 40+	9	2.88 (6.83)	3.50 (8.38)	2.32 (4.99)	*
	10	2.89 (5.80)	3.41 (6.84)	2.45 (4.69)	*
	11	3.12 (6.40)	3.87 (7.57)	2.48 (5.10)	*
	12	2.99 (6.29)	3.96 (7.80)	2.15 (4.43)	*
Depressed Mood Range: 4 (low) to 20 (high)	9	10.00 (3.27)	9.36 (3.01)	10.58 (3.38)	*
	10	10.23 (3.30)	9.61 (3.12)	10.78 (3.37)	*
	11	10.28 (3.36)	9.80 (3.25)	10.69 (3.39)	*
	12	10.32 (3.16)	9.79 (3.13)	10.76 (3.12)	*
Sample/Subsample Sizes		1,015	481	534	