

# Childhood Depressive Symptoms and Adolescent Cigarette Use: A Six-Year Longitudinal Study Controlling for Peer Relations Correlates

Mitchell J. Prinstein  
University of North Carolina at Chapel Hill

Annette M. La Greca  
University of Miami

**Objective:** To examine potential pathways between childhood depressive symptoms and adolescent cigarette use, controlling for potential “third variable” causes. **Design:** Participants included 250 youth (60% girls) who were in Grades 4 to 6 at study outset and in Grades 10 to 12 ( $M$  age = 16.78) at a 6-year follow-up. At Time 1, children completed measures of depressive symptoms, as well as peer nominations of peer acceptance, rejection, and aggressive behavior. **Main Outcome Measures:** Time 2 measures included adolescents’ own and close friends’ cigarette use, depressive symptoms, and externalizing behaviors; parents also reported on adolescent behaviors. **Results:** Higher levels of childhood depressive symptoms and aggressive behavior were associated longitudinally with cigarette use in adolescence. After controlling for other associations, higher levels of childhood depressive symptoms also were associated with higher levels of friends’ cigarette use in adolescence and higher levels of adolescent depressive symptoms; each of these adolescent outcomes was concurrently associated with cigarette use. **Conclusion:** Depressive symptoms in childhood may lead to altered developmental trajectories that either directly or indirectly contribute to adolescent outcomes, including cigarette use.

**Keywords:** adolescence, nicotine use, depressive symptoms

Tobacco use has been identified by the Centers for Disease Control and Prevention (CDC, 2006) as one of the leading preventable causes of death in the United States. A recent national survey revealed that 54.3% of adolescents nationwide have tried cigarette smoking, and 23% smoked one or more cigarettes in the previous 30-day period (CDC, 2006). Adolescent cigarette smoking is a particularly significant health-risk behavior because it often persists into adulthood (Chassin, Presson, Sherman, & Edwards, 1990). In fact, almost all adult smokers began using cigarettes before 18 years of age (U.S. Department of Health & Human Services, 1994). Thus, efforts to understand the factors that contribute to the initiation and maintenance of adolescent smoking represent an important public health issue. Moreover, understanding factors that set the stage for adolescent smoking would be especially valuable, because once adolescents initiate smoking they are at extremely high risk for becoming daily and long-term cigarette users (Patton et al., 1998; Patton, Coffey, Carlin, Sawyer, & Wakefield, 2006).

Using a developmental framework, the present study examined childhood depressive symptoms as a predictor of adolescent cigarette use. To our knowledge, this study is one of very few to examine childhood depressive symptoms as a potential predictor

of adolescent smoking, and thus addresses an important gap in the existing smoking literature. We focused on childhood depressive symptoms as a potential precursor to adolescent smoking because a large body of research highlights the role of depressive symptoms in smoking behaviors among adults and adolescents, as noted below. Yet there remains considerable debate regarding the direction of effect between depressive symptoms and cigarette use; a long-term longitudinal study can begin to address this issue developmentally. In addition, there has been some suggestion that prior studies of the apparent association between depressive symptoms and cigarette use may not have fully considered possible “third variables” that are associated with each construct, and may account for their association (Breslau et al., 1993; Johnson, Rhee Chase, & Breslau, 2004). This long-term developmental investigation addressed this concern by specifically examining interrelated predictors and outcomes, while stringently testing the depressive symptom-cigarette use link.

Among adults, substantial work has suggested that depressive symptoms may be an important risk factor for the initiation or maintenance of smoking (Anda et al., 1990; Breslau, Peterson, Schultz, Chilcoat, & Andreski, 1998; Kandel & Davies, 1986; Leventhal, Ramsey, Brown, LaChance, & Kahler, 2008). Although studied relatively infrequently, some longitudinal studies similarly have suggested that adolescent depressive symptoms predicts later adolescent smoking (Fergusson, Goodwin, & Horwood, 2003; Killen et al., 1997; Patton et al., 2006; Repetto, Caldwell, & Zimmerman, 2005). Findings suggesting that depressive symptoms precede and perhaps contribute to smoking are consistent with the idea that cigarette smoking maybe used as a strategy for self-medication of negative affect and distress (e.g., Killen et al., 1997).

Yet, an opposite direction of effect between depressive symptoms and cigarette use also has been suggested. Among adults,

---

Mitchell J. Prinstein, Department of Psychology, University of North Carolina at Chapel Hill; Annette M. La Greca, Department of Psychology, University of Miami.

Portions of this work were funded by a grant to Annette M. La Greca from the National Institute of Mental Health, RO1-MH48082.

Correspondence concerning this article should be addressed to Mitch Prinstein, University of North Carolina at Chapel Hill, Department of Psychology, Davie Hall, Campus Box 3270, Chapel Hill, NC 27599-3270, E-mail: mitch.prinstein@unc.edu

longitudinal results suggest that cigarette use may exacerbate depressive symptoms (Benjet, Wagner, Borges, & Mendina-Mora, 2004; Breslau, Kilbey, & Andreski, 1991; Breslau et al., 1998; Burgess et al., 2002; Kendler et al., 1993), and depressive symptoms may mitigate the effects of smoking cessation interventions, although findings have been mixed (cf., Brown et al., 2001; 2007; Catley et al., 2005; Glassman et al., 1990; Hayford et al., 1999; Hitsman, Borelli, McChargue, Spring, & Niaura, 2003; Kodl et al., 2008). Some data among adolescents also suggest that cigarette smoking is related to later depressive symptoms in adolescence (e.g., Brown, Lewinsohn, Seeley, & Wagner, 1996; Munafò, Hitsman, Rende, Metcalfe, & Niaura, 2008; Steuber & Banner, 2006; Wu & Anthony, 1999) or years later in adulthood (Brook, Schuster, & Zhang, 2004). These results are consistent with theories suggesting that nicotine suppresses neurochemical systems associated with positive affect or emotion regulation, perhaps contributing to depressive symptoms (Pomerleau & Pomerleau, 1984; Quattrocki, Baird, & Yurgelun-Todd, 2000). Data from short-term, cross-lagged longitudinal studies among adolescents even suggest bidirectional associations between cigarette use and depressive symptoms in adolescence (e.g., Brown, Lewinsohn, Seeley, & Wagner, 1996; Windle & Windle, 2001).

The present 6-year longitudinal study offered a rare and needed opportunity to determine whether childhood depressive symptoms are associated with later cigarette use in adolescence, adopting a developmental perspective. In this long-term longitudinal study, cigarette use was not conceptualized as an immediate response to depressive symptoms. Rather, it was possible to examine whether depressive symptoms (or perhaps related indices of childhood social-psychological maladjustment) were uniquely associated with later cigarette use (or perhaps more directly with adolescent correlates of cigarette use). Thus, this model allowed for a stringent examination of a long-term link between childhood depressive symptoms and later cigarette use, and allowed for the control of relevant "third variables." As delineated below, both direct and indirect pathways between childhood depressive symptoms and adolescent smoking were evaluated, and analyses controlled for potentially confounding variables. In short, this study contributes to the existing literature on smoking by thoroughly and stringently examining the association between depressive symptoms and cigarette use during a critical period associated with the onset of smoking behavior.

In considering childhood factors that may predict cigarette use in adolescence, we drew on a developmental psychopathology framework, using the concepts of *multifinality* and *equifinality*. Specifically, the concept of multifinality suggests that a particular risk factor could lead to multiple maladaptive outcomes, and the concept of equifinality suggests that multiple risk factors could lead to a particular maladaptive outcome (Rutter & Sroufe, 2000). Both psychological symptoms and peer relations are important additional variables to consider as potential risk factors and outcomes that could be associated with cigarette use. Among adolescents, for instance, substantial research has suggested that externalizing symptoms are strongly associated with the use of substances, including cigarettes (Dishion, Capaldi, Spracklen, & Li, 1995). In addition, peer factors are among the most potent and consistent predictors of adolescent cigarette use; indeed, the vast majority of adolescents (90%) smoke their first cigarette in the presence of peers (La Greca & Fisher, 1992). Thus, each of these

areas of functioning (externalizing behaviors, peer relations) were especially considered.

First, it is important to consider the multifinality of childhood depressive symptoms as a risk factor associated with many potential maladaptive outcomes, including cigarette smoking. For instance, past research has suggested that depressive symptoms co-occur with externalizing symptoms, particularly among girls (Keenan, Loeber, & Green, 1999). Research also has suggested that higher levels of depressive symptoms are associated with deviant peer affiliations (Brendgen, Vitaro, & Bukowski, 2000). Both externalizing symptoms and deviant peer affiliations, in turn, are robust correlates of adolescent cigarette use (Dishion et al., 1995). In particular, substantial work has suggested that adolescent cigarette use is strongly associated with the proportion of adolescents' friends who also use cigarettes (Kobus, 2003; Lloyd-Richardson, Papandonatos, Kazura, Stanton, & Niaura, 2002; Urb-erg, Degirmencioglu, & Pilgrim, 1997). Therefore, the present study examined childhood depressive symptoms as a predictor of multiple adolescent outcomes (cigarette smoking, friend's cigarette smoking, and externalizing behaviors). Moreover, to examine the specificity of the association between childhood depressive symptoms and adolescent cigarette use, we controlled for the shared associations between adolescent cigarette use and both externalizing behaviors and friends' cigarette use when conducting the longitudinal, prospective analyses.

We additionally controlled for adolescent depressive symptoms in the prospective analyses, as there appears to be moderate stability of depressive symptoms from childhood to adolescence (Tram & Cole, 2006), and adolescent depressive symptoms are known to be correlated with adolescent cigarette use. If childhood depressive symptoms predict adolescent smoking while controlling for adolescent depressive symptoms, as we hypothesize, this would suggest that childhood depressive symptoms alter developmental trajectories in a manner that produces a risk for later cigarette use. For instance, depressive symptoms in childhood may inhibit the development of emotional regulation skills over time (Lewinsohn, 1974), the formation of long-term relationships that could offer social support in adolescence (Coyne, 1976), or promote a general tendency toward adolescent risk behaviors (Lewinsohn, Rohde, & Seeley, 1998). Thus, the present study examined the early depressive symptoms as a predictor of adolescent cigarette use, while controlling for its shared associations with adolescent externalizing behavior, friends' cigarette use, and adolescent depressive symptoms.

Second, the study also considered the *equifinality* of adolescent cigarette use, as an outcome that may have multiple predictors. Specifically, two additional childhood variables known to be associated longitudinally with adolescent substance use were examined as predictors, to evaluate their relationship to adolescent cigarette smoking and to stringently test the specificity of childhood depressive symptoms as a predictor of adolescent cigarette use.

Substantial research has suggested that children who are rejected by peers are at greater risk of later maladaptive and risk behavior outcomes, including cigarette use (e.g., Dishion et al., 1995). In addition, children's aggressive behavior toward peers (often used as a proxy for childhood externalizing symptoms; Coie & Dodge, 1998), is especially associated with the development of adolescent risk behaviors (e.g., Miller-Johnson, Lochman, Coie,

Terry, & Hyman, 1998). Because both peer rejection and aggression also are associated with depressive symptoms in childhood (Panak & Garber, 1992), it is important to evaluate whether childhood depressive symptoms is a unique predictor of adolescent cigarette use, or whether childhood depressive symptoms may be serving as a marker for these peer relations correlates that are known to be associated with adolescent cigarette use. Thus, in the current study, the role of childhood depressive symptoms as a predictor of adolescent cigarette use was examined while controlling for these other significant childhood variables.

Finally, gender was examined as a potential moderator of the association between childhood depressive symptoms and adolescent cigarette use. Prior investigations of adolescents that examined gender as a moderator of the depression-smoking association have yielded mixed findings (cf., Conrad, Flay, & Hill, 1992; Killen et al., 1997; Miller-Johnson et al., 1998; Repetto et al., 2005). Yet depressive symptoms are frequently endorsed at higher frequencies among females, particularly in adolescence (Hankin & Abramson, 2001; Nolen-Hoeksema & Girgus, 1994; Sterba, Prinstein, & Cox, 2007). In contrast, males typically engage in higher levels of deviant peer affiliation in adolescence, as well as higher levels of aggression in childhood (Dishion et al., 1995). Interestingly that no gender differences are observed in the frequency of adolescent cigarette use (CDC, 2006).

In summary, data for this study were collected at two time points over a 6-year interval (middle childhood and mid-adolescence) and used to examine the specificity of the association between childhood depressive symptoms and adolescent cigarette use, and potential moderating effects for gender. Analyses allowed for a stringent test of the prospective depression-smoking association by controlling for shared associations among correlated constructs at each developmental stage.

## Method

### Participants

Participants were 250 youth (99 boys; 151 girls) who were in Grades 4 to 6 at the outset of the study, and in Grades 10 to 12 (aged 15 to 18 years;  $M = 16.78$ ;  $SD = .89$ ) when the study was completed. The sample was 45.6% White/Caucasian ( $n = 114$ ), 37.2% Hispanic American ( $n = 93$ ), 12.8% African American ( $n = 32$ ), and 4.4% Asian American/Other ( $n = 11$ ). Socioeconomic status for this sample was predominantly middle class, as categorized by Hollingshead Social Class (Level I: 36.3%; Level II: 41.0%; Level III: 15.7%; Level IV: 4.7%; Level V: 2.3%).

### Procedure

A sample of 490 children participated in this study at Time 1, including fourth, fifth, and sixth grade students from three public elementary schools in a large urban metropolitan area in the Southeast. These schools were selected to represent the demographic characteristics of the surrounding county. All study procedures and consent forms were approved by the University's Institutional Review Board. Active parental consent was required for children's study participation, as well as active child assent. Information regarding the study and parental consent forms were distributed by classroom teachers; children brought materials

home to their parents for review. Parental consent was obtained for 85% of the possible child participants at Time 1. During this initial assessment children completed questionnaires and peer nominations in their classrooms assisted by research assistants.

Six years later (Time 2), these students were tracked through the county public school database. By Time 2, 184 of the students (38%) were unable to be contacted (112 had withdrawn from the local school district; 72 did not have accurate contact information or were unable to be reached). Of the remaining 306 who were able to be contacted, parental consent was obtained for 250 adolescents (82%), all of whom agreed to participate. The final sample of 250 adolescents with complete data at both time points did not differ statistically from the 240 who did not participate at Time 2 on measures of depressive symptoms, peer status, aggressive behavior among peers, or any demographic variables, with once exception. Girls were slightly overrepresented in the retained sample (59.6% of retained sample, 52.7% of original sample),  $\chi^2(1) = 9.88$ ,  $p < .01$ . Of the 306 adolescents who could be contacted at Time 2, no significant differences on any study measures were revealed between the 250 who participated and the 56 who did not have permission to participate.

At Time 2, adolescents and their parents completed questionnaires during individual home interviews conducted by trained research assistants. Adolescents were paid \$40.00 for their time and participation. Written informed consent was obtained from adolescents and their parents prior to participation.

### Measures

*Cigarette use.* The Survey of Risk Taking Behaviors (La Greca, Prinstein, & Fetter, 2001) was administered to adolescents at Time 2. This measure assesses a range of health risk behaviors using items from prior instruments (Biglan, Metzler, Wirt, & Ary, 1990; CDC, 2006; Jessor, Donovan, & Costa, 1991; Levine & Singer, 1988) and from the Youth Risk Behavior Surveillance System (CDC, 2006). Cigarette use was measured by two items. One item asked whether an adolescent had "ever smoked a cigarette," using a yes/no response format. The second item assessed smoking frequency ("On average, in the past month/30 days, how many cigarettes have you smoked each day?"), using a 1 (None) to 6 (More than 20) response format. As described below, a latent construct of adolescents' cigarette use at Time 2 was modeled using these two items as observed indicators. Jessor and colleagues (1991) have reported adequate validity for these items, including significant associations between measures of cigarette use and deviant behavior. Using this measure, La Greca et al. (2001) found that adolescents' affiliation with deviant peer crowds was linked with significantly higher levels of cigarette use.

Adolescents' friends' cigarette use also was measured using this instrument. Adolescents initially were asked to list the names of up to five close friends. Next, adolescents were asked to indicate how many of these close friends (0–5) engaged in a variety of deviant and health risk behaviors, including the number of their friends who "smoked cigarettes." A proportion score computed by dividing adolescents' response to the number of their friends who "smoked cigarettes" by their total number of friends was used as a measure of friends' cigarette use.

*Depressive symptoms.* At both time points, participants completed the Children's Depression Inventory (CDI; Kovacs, 1992).

The CDI contains 27-items that assess cognitive and behavioral depressive symptoms. One item assessing suicidal ideation was omitted at the request of the University Internal Review Board. Participants rated each item on a 3-point scale (0, 1, 2) that reflected their level of depressive symptoms in the previous 2 weeks. A total score was computed with higher scores reflecting more depressive symptoms. Good psychometric properties have been reported for the CDI as a reliable and valid index of depressive symptoms; it can be used with youth between the ages of 7 and 18 years of age (Kazdin, 1990). In the current sample, internal consistency was adequate at both time points, Time 1  $\alpha = .84$ ; Time 2  $\alpha = .86$ .

*Peer acceptance/rejection and aggression.* A standard sociometric peer nomination procedure (Coie & Dodge, 1983) was conducted at Time 1 to obtain measures of peer acceptance/rejection and each participant's aggressive behavior among peers (i.e., peer aggression). All youth were asked to nominate three classmates they "liked most" and "liked least," from a list of their same-sex classmates who were participating in the study. A total number of nominations received by classmates was computed for each participant, and this total was standardized within gender and within each classroom (Coie & Dodge, 1983). Thus, each participant had a standardized score representing the extent to which they were nominated by their classmates as "liked most" and "liked least" as compared to other same-gender students in their class. For each participant, a difference score between the standardized "liked most" and "liked least" nominations was computed and restandardized as a measure of social preference (Coie & Dodge, 1983). High social preference scores reflect high levels of peer acceptance, whereas low social preference scores reflect high levels of peer rejection (Coie & Dodge, 1983).

Using a similar procedure, children also were asked to nominate peers who "start fights," are "bossy," "interrupt others," and "doesn't pay attention." For each of these items, a total number of nominations received by classmates was computed for each participant, and this total was standardized within gender and within each classroom (Coie & Dodge, 1983, 1988). For each participant, a mean score was computed using standardized nomination scores for these four items, yielding a single index of each participant's aggressive behavior toward peers ( $\alpha = .70$ ). Thus, each participant had a mean score representing the extent to which they were nominated by their classmates as aggressive as compared to other same-gender participating students in their class. (All analyses reported below were repeated using only the "starts fights" nomination as a measure of aggression toward peers; obtained results were identical). Prior research indicates that peer nominations are reliable and valid indices of peer preferences and aggressive/externalizing behavior, with good test-retest reliability (Coie & Dodge, 1983, 1988).

*Externalizing behavior.* At Time 2, the Youth Self Report (YSR) and Child Behavior Checklist (CBCL) (Achenbach & Edelbrock, 1987, 1991) were administered to adolescents and parents, respectively, to examine externalizing behavior. Each instrument examines a range of behavior problem items (YSR = 102 items; CBCL = 118 items) that are rated as "not true," "sometimes true," or "often true." A normalized *T* score was computed for the broad-band Externalizing Composite Index on the CBCL and the YSR. The reliability, validity, and norms for each instrument have been well documented (Achenbach & Edelbrock, 1987, 1991).

### Data Analysis

First, means and standard deviations were computed for all study variables, and potential gender differences in the variables were evaluated. Bivariate correlations also were computed among all continuous study variables. Next, an overall model was used to evaluate associations among all childhood and all adolescent variables. Specifically, the model evaluated in this study examined childhood depressive symptoms as a predictor of adolescent cigarette use, while controlling for the shared associations between cigarette use and adolescent externalizing behavior, friends' cigarette use, and adolescent depressive symptoms. Further, in examining childhood depressive symptoms as a predictor of adolescent cigarette use, the potential longitudinal effects of childhood peer rejection and peer aggression on adolescent cigarette smoking were also controlled.

The proposed model was examined using multiple group structural equation modeling using full information maximum likelihood as implemented in Amos version 6.0 (Arbuckle, 1999; see Figure 1). For both groups (i.e., for boys and girls), Time 1 predictors included children's self-reported depressive symptoms, peer-reported social preference, and peer nominations of aggressive behavior; each predictor was included in the model as an exogenous variable. Covariance among all predictors was estimated. Four Time 2 variables were included in the model. Two of the variables, friends' cigarette use and depressive symptoms at Time 2, were measured by "observed indicators." The other two variables, adolescent cigarette use and adolescent externalizing symptoms, were latent variables that were modeled. A latent factor of adolescent cigarette use was estimated using the two cigarette use items described above as indicators. A latent factor of adolescent externalizing symptoms was estimated using externalizing scores on the CBCL and YSR as indicators. Covariation was estimated between all error terms from the four Time 2 outcomes (i.e., friends' cigarette use, adolescent depressive symptoms, the latent factor for cigarette use, and the latent factor for externalizing symptoms).

A multiple group analysis was conducted to yield separate standardized estimates for boys and girls. The statistical significance of gender interactions was examined by comparing models with paths either fixed or free to vary between groups. The significance of  $\chi^2$  difference tests between nested models was used to evaluate gender differences in the magnitude of estimated paths.

## Results

### Descriptive Analyses

Table 1 presents means and standard deviations for all study variables, as well as the results of *t* tests and chi-square tests conducted to examine gender differences. In adolescence (Time 2), more boys reported lifetime cigarette use ("ever smoked a cigarette") than did girls, and boys reported a higher current frequency of cigarette smoking than did girls. In addition, as compared to boys, girls reported lower levels of depressive symptoms in childhood and higher levels in adolescence. Consistent with epidemiological data (CDC, 1996), African American youth (42.1%) reported lower levels of lifetime cigarette use than did White/Caucasian (63.3%) or Latino American (64.6%) participants,  $\chi^2(2) = 6.33, p < .05$ . Preliminary analyses (identical to those

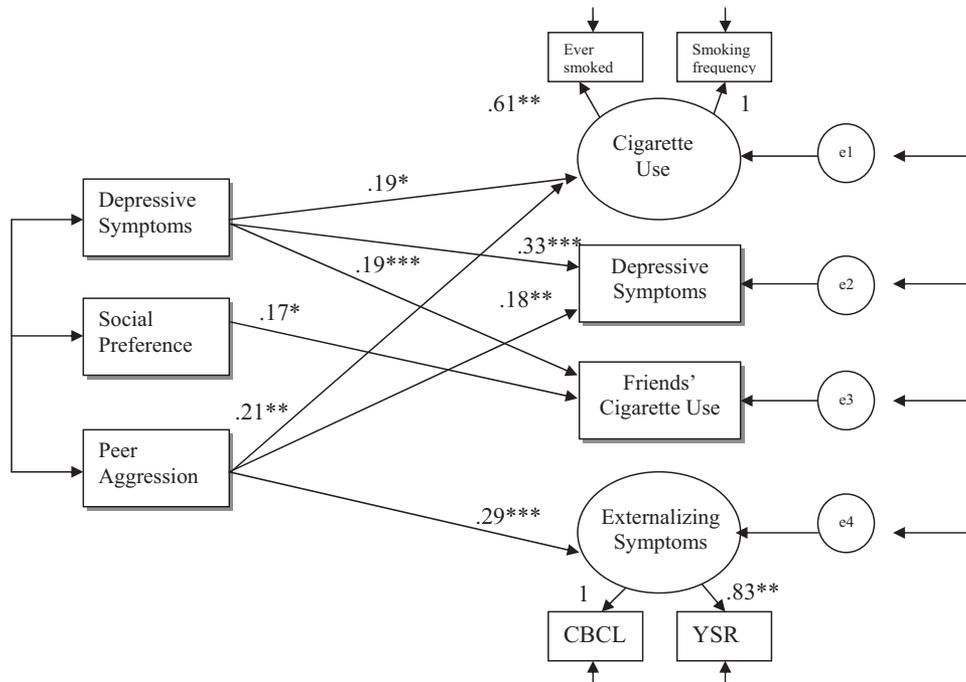


Figure 1. Standardized path weights from a structural equation model examining longitudinal associations among childhood depressive symptoms, adolescent cigarette use, and correlates. \*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

below) examining ethnicity as a moderator of associations revealed no significant moderating effects. Therefore, analyses without ethnicity are presented below to retain maximal power for hypothesized associations.

Table 2 presents bivariate correlations between all primary study variables. As expected, the three childhood predictors (i.e., depressive symptoms, social preference, aggression toward peers) were significantly intercorrelated. The adolescent outcomes (i.e., frequency of cigarette use, depressive symptoms, friends' cigarette use, externalizing symptoms reported by parents and adolescents) also were significantly intercorrelated.

Model Testing

A structural equation model including the three childhood predictors (depressive symptoms, social preference, aggressive behavior) and four adolescent outcomes (adolescent cigarette smoking, friends' cigarette smoking, adolescent depressive symptoms, adolescent externalizing behaviors) was examined. An initial model examined pathways between each predictor and each outcome, with all paths and all covariances constrained to be equal across gender. Model fit was good,  $\chi^2(66) = 41.56$ ,  $\chi^2/df = .99$ , CFI = 1.00, RMSEA = .01, AIC = 175.53, see Figure 1. Table 3

Table 1  
Means (and Standard Deviations) for All Study Variables

	Boys	Girls	t (df = 248)
Time 1 Variables			
Depressive symptoms	9.19 (6.30)	7.57 (6.26)	1.99*
Social preference <sup>a</sup>	.06 (1.04)	.03 (1.00)	.25
Aggression towards peers <sup>a</sup>	-.07 (.58)	.04 (.80)	-1.13
Time 2 Variables			
Ever smoked cigarette? (n, % yes)	69 (70.0%)	30 (19.9%)	$\chi^2(1) = 7.17^{***}$
Cigarette use frequency/per day <sup>b</sup>	1.86 (1.42)	1.52 (1.23)	1.98*
Depressive symptoms	6.09 (5.14)	7.79 (6.59)	-2.25*
Friends' cigarette use <sup>c</sup>	.39 (.35)	.33 (.33)	1.27
Externalizing symptoms (CBCL) <sup>d</sup>	48.81 (9.37)	49.50 (10.72)	-.51
Externalizing symptoms (YSR) <sup>d</sup>	54.26 (9.86)	55.43 (8.90)	-.97

<sup>a</sup> These variables are standardized scores where the  $M = 0$  and the standard deviation = 1; <sup>b</sup> Scale reflects 1 (None) to 6 (More than 20); <sup>c</sup> Proportion of closest friends who smoke cigarettes (range = .00 to 1.00); <sup>d</sup> Standardized t-score ( $M = 50$ ,  $SD = 10$ ).  
\*  $p < .05$ . \*\*  $p < .01$ .

Table 2  
Bivariate Associations Among All Primary Study Variables

	Childhood predictors		Adolescent outcomes				
	Aggression towards peers	Social preference	Depressive symptoms	Cigarette use (frequency)	Friends' cigarette use	Ext. symp. parent report	Ext. symp. child report
Childhood predictors							
Depressive symptoms	.15*	-.28***	.28***	.18**	.17**	.06	.10
Peer aggression towards peers		-.41***	.22***	.16*	.07	.24**	.22**
Social preference			-.06	-.09	.07	-.04	-.05
Adolescent outcomes							
Depressive symptoms				.27***	.26***	.17**	.43***
Cigarette use					.45***	.21**	.28***
Friends' cigarette use						.18**	.26***
Externalizing symp., parent report							.33***

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

presents the covariances (and correlations) for all associations among predictors and among outcomes as well as the unstandardized (and standardized) path weights for all longitudinal associations.

Before discussing longitudinal pathways, it is important to note that even after accounting for all other estimated paths, the childhood predictor variables remained significantly intercorrelated; in addition, adolescent outcomes remained intercorrelated. Specifically, children who reported higher levels of depressive symptoms also were less accepted by their peers (lower social preference scores) and were more likely to be viewed by peers as aggressive. Similarly, the adolescent outcome variables were also interrelated. In particular, higher levels of cigarette smoking in adolescence were associated with more depressive symptoms, more externalizing behavior problems, and having a higher number of close friends who smoked.

Before discussing longitudinal pathways, it also is important to note the effects of gender moderation testing. To examine gender moderation, individual paths and covariances were allowed to vary

across gender, and chi-square difference tests were examined to determine significant improvement in model fit. Model fit was improved significantly by allowing only one path to freely vary by gender: covariance between childhood aggressive behavior toward peers and childhood social preference,  $\Delta\chi^2(1) = 7.71, p < .01$ , suggesting gender moderation. Specifically, the association between childhood high levels of aggressive behavior and low social preference was weaker among boys,  $b = -.14; B = -.24, p < .05$ , than among girls,  $b = -.39; B = -.49, p < .0001$ . All other paths remained fixed across gender suggesting that gender did not moderate any of the other concurrent associations examined or any of the longitudinal associations examined. The final model fit was satisfactory,  $\chi^2(67) = 33.85, \chi^2/df = .83, CFI = 1.00, RMSEA = .00, AIC = 167.85$ . Figure 1 offers a representation of the final model including significant longitudinal paths.

These results revealed that, after accounting for shared variability among predictors and shared variability among outcomes, both higher levels of childhood depressive symptoms and aggressive behavior toward peers were associated longitudinally with ciga-

Table 3  
Unstandardized (and Standardized) Path Weights and Covariances (Correlations) Among Childhood Predictors and Adolescent Outcomes

	Childhood predictors		Adolescent outcomes			
	Peer aggression	Social preference	Cigarette use <sup>a</sup>	Friends' cigarette use	Externalizing symptoms <sup>b</sup>	Depressive symptoms
Childhood predictors						
Depressive symptoms	.02 (.17)*	-.06 (-.26)***	.57 (.19)*	.84 (.19)**	2.50 (.3)	.28 (.33)***
Peer aggression	A	.26 (.21)**	.17 (.09)	2.27 (.29)***	.06 (.18)**	
Social preference			.04 (.06)	.17 (.17)*	.46 (.10)	.02 (.11)
Adolescent outcomes						
Cigarette use				.04 (.33)***	1.55 (.53)***	.04 (.33)***
Friends' cigarette use					1.47 (.33)***	.40 (.59)***
Externalizing symptoms						.42 (.55)***

Note. A = This path weight varied by gender; boys:  $-.14 (-.24), p < .05$ ; girls:  $-.39 (-.49), p < .0001$ .

<sup>a</sup> Cigarette use was modeled as a latent construct. The loading for cigarette use frequency was fixed to 1 (beta = .66), the dichotomous indicator loaded significantly,  $b = .41 (B = .61), p < .001$ .

<sup>b</sup> Externalizing symptoms were modeled as a latent construct; The loading for parent report was fixed to 1 (beta = .50), adolescent report loaded significantly,  $b = 1.767 (B = .83), p < .001$ .

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

rette use in adolescence. Several indirect pathways between childhood depressive symptoms and adolescent cigarette use also were observed. For example, after controlling for other significant associations, higher levels of childhood depressive symptoms were associated with higher levels of perceptions of friends' cigarette use in adolescence and with higher levels of adolescent depressive symptoms; in turn, each of these adolescent outcomes was concurrently associated with adolescent cigarette use.

There also was evidence of indirect pathways between childhood aggressive behavior toward peers and adolescent cigarette use. For example, after controlling for other significant associations, higher levels of childhood aggressive behavior were associated with adolescents' depressive and externalizing symptoms; in turn, both adolescent depressive and externalizing symptoms were concurrently associated with cigarette smoking.

Last, it is noteworthy that childhood social preference (i.e., peer acceptance/rejection) was not longitudinally associated with adolescent cigarette use, although it was associated with higher perceptions of friends' cigarette use. Children with higher social preference reported having a higher proportion of friends' who smoked cigarettes in adolescence than did less accepted youth.

### Discussion

Although many short-term longitudinal studies have examined the association between depressive symptoms and cigarette use in adulthood or adolescence, few long-term longitudinal studies are available to examine whether childhood depressive symptoms may be prospectively associated with adolescent cigarette use. By examining childhood depressive symptoms and adolescent cigarette use, each in the context of several additional contemporaneous correlates, it was possible to examine the specificity of this association as well as other potential pathways. Analyses also were conducted to examine gender moderation.

This study revealed a significant association between childhood depressive symptoms and adolescent cigarette use. In past work, evidence for a short-term temporal association has been used to suggest a causal link between negative affect and the use of nicotine as a self-medication strategy. Caution is needed when drawing similar conclusions from these results, however. Findings revealed that even after controlling for the stability of depressive symptoms over development, and the concurrent association between adolescent depressive symptoms and cigarette use, childhood depressive symptoms remained a significant unique predictor of adolescent smoking. It is implausible to assume that cigarette use followed from the experience of negative affect 6 years earlier. However, it is possible that childhood depressive symptoms indirectly are associated with later cigarette use via ongoing negative affect or a diminished capacity to cope with affective distress.

Still, the direct, significant association between childhood depressive symptoms and adolescent cigarette use, even after controlling for adolescent depressive symptoms, suggests that additional mechanisms may be worth exploring in future research. For instance, as has been suggested previously, these findings are consistent with a common etiology theory, suggesting that a "third variable" causes both the development of depressive symptoms in childhood and cigarette use in adolescence. Results from this study suggest that this third variable is not likely to be either childhood peer status (i.e., acceptance/rejection) or aggressive behavior to-

ward peers; an association between childhood depressive symptoms and adolescent cigarette use remained even after controlling for these variables. Several other potential common factors have been suggested in the literature (e.g., temperament, social-cognitive biases). Social-cognitive biases, such as a hostile attribution bias for instance, may be associated both with depressive symptoms in childhood (Quiggle, Garber, Panak, & Dodge, 1992) as well as the use of substances in adolescence (Fontaine, 2006); this offers an important avenue for future work.

A second possible interpretation of findings pertains to the manner in which depressive symptoms in childhood may contribute to altered developmental trajectories that either directly or indirectly contribute to adolescent outcomes, including cigarette use. This interpretation rarely has been considered in the literature on depressive symptoms and cigarette use, yet results from this study suggest that such a model may be worth examining. For example, results suggested that childhood depressive symptoms were associated both with adolescent cigarette use, as well as with perceptions of friends' cigarette use, even after controlling for shared associations. In other words, results supported the multifinality of depressive symptoms as a predictor associated with several outcomes, each presenting a unique risk for ongoing cigarette use. Past work suggests that childhood depressive symptoms may have numerous deleterious effects on social development, including deprivation of socially rewarding experiences among peers, diminished opportunities to develop emotion recognition skills, and lack of friendship support during times of stress (Lewinsohn, 1974). Youth with poor competence in these domains as compared to age-mates are particularly susceptible to affiliation with deviant youth (Fergusson & Horwood, 1999), and substantial research suggests that acceptance and continued affiliation with a deviant peer group may require participation in behaviors that establishes this group's identity, such as smoking (Fergusson & Horwood, 1999). Thus, it may be that depressive symptoms have direct consequences on social development skills that render adolescents vulnerable to contagion among peers. Data from this study cannot speak to specific mechanisms, but do suggest that the indirect association between depressive symptoms, deviant peer affiliation, and cigarette use deserves further examination.

Overall, this study used a rigorous design to examine associations between depressive symptoms and cigarette use. Data were collected from adolescents, parents, and peers, and analyses offered a conservative and stringent examination of associations. Several limitations should be noted, however. First, the examination of constructs in an urban, diverse community-based sample allowed for an examination of associations in a manner that might have most direct implications for broad, primary prevention efforts; however, the relatively low prevalence of depressive symptoms prohibit generality to more severe populations. Efforts to extend this line of research to a clinical population of depressed youth would be important. Second, the initial examination of constructs during elementary school years precluded an examination of bidirectional associations between depressive symptoms and cigarette use. This will be important to explore further in long-term longitudinal work as well. Third, this study did not include additional assessments of psychological functioning within the 6-year longitudinal interval; future studies that evaluate psychological functioning at multiple and shorter time intervals may have revealed numerous mediating processes or reciprocal associ-

ations that could further elucidate the nature of the associations between childhood and adolescent factors. Fourth, although this study included a measure of aggression within the peer context, which may serve as a proxy for childhood externalizing symptoms, a broader measure of externalizing symptoms in childhood was not available, and would be useful to consider in future studies. Finally, participant attrition over the 6-year interval averaged about 7% a year. Although this rate of attrition is reasonable, efforts to retain a higher percentage of participants over the interval from childhood to adolescence would be desirable in future long-term studies.

Overall, this study offered a rare opportunity to understand the long-term associations between depressive symptoms and cigarette use within a youth population. Even after controlling for numerous childhood and adolescent correlates, childhood depressive symptoms, even at subclinical levels, seems to be relevant as a predictor for later cigarette use.

## References

- Achenbach, T. M., & Edelbrock, C. S. (1987). *Manual for the Youth Self-Report and Profile*. Burlington, VT: University of Vermont, Department of Psychiatry.
- Achenbach, T. M., & Edelbrock, C. S. (1991). *Manual for the Child Behavior Checklist and Revised Child Behavior Profile*. Burlington, VT: University of Vermont, Department of Psychiatry.
- Anda, R. F., Williamson, D. F., Escobedo, L. G., Mast, E. E., Giovino, G. A., & Remington, P. L. (1990). Depression and the dynamics of smoking: A national perspective. *Journal of the American Medical Association*, *264*, 1541–1545.
- Arbuckle, J. L. (1999). Amos (Version 4.0) [Computer Software]. Chicago: Smallwaters.
- Benjet, C., Wagner, F. A., Borges, G. G., & Mendina-Mora, M. E. (2004). The relationship of tobacco smoking with depressive symptomatology in the Third Mexican National Addictions Survey. *Psychological Medicine*, *34*, 1–8.
- Biglan, A., Metzler, C. W., Wirt, R., & Ary, D. V. (1990). Social and behavioral factors associated with high-risk sexual behavior among adolescents. *Journal of Behavioral Medicine*, *13*, 245–261.
- Brendgen, M., Vitaro, F., & Bukowski, W. M. (2000). Deviant friends and early adolescents' emotional and behavioral adjustment. *Journal of Research on Adolescence*, *10*, 173–189.
- Breslau, N., Kilbey, M., & Andreski, P. (1991). Nicotine dependence, major depression, and anxiety in young adults. *Archives of General Psychiatry*, *48*, 1069–1074.
- Breslau, N., Kilbey, M. M., & Andreski, P. (1993). Nicotine dependence and major depression: New evidence from a prospective investigation. *Archives of General Psychiatry*, *50*, 31–35.
- Breslau, N., Peterson, E. L., Schultz, L. R., Chilcoat, H. D., & Andreski, P. (1998). Major depression and levels of smoking: A longitudinal investigation. *Archives of General Psychiatry*, *55*, 161–166.
- Brook, J. S., Schuster, E., & Zhang, C. (2004). Cigarette smoking and depressive symptoms: A longitudinal study of adolescents and young adults. *Psychological Reports*, *95*, 159–166.
- Brown, R. A., Kahler, C. W., Niaura, R., Abrams, D. B., Sales, S. D., Ramsey, S. E., et al. (2001). Cognitive-behavioral treatment for depression in smoking cessation. *Journal of Consulting and Clinical Psychology*, *69*, 471–480.
- Brown, R. A., Lewinsohn, P. M., Seeley, J. R., & Wagner, E. F. (1996). Cigarette smoking, major depressive symptoms, and other psychiatric disorders among adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry*, *35*, 1602–1610.
- Brown, R. A., Niaura, R., Lloyd-Richardson, E. E., Strong, D. R., Kahler, C. W., Abrantes, A. M., et al. (2007). Bupropion and cognitive-behavioral treatment for depression in smoking cessation. *Nicotine and Tobacco Research*, *9*, 721–730.
- Burgess, E. S., Brown, R. A., Kahler, C. W., Niaura, R., Abrams, D. B., Goldstein, M. G., & Miller, I. W. (2002). Patterns of change in depressive symptoms during smoking cessation: Who's at risk for relapse? *Journal of Consulting and Clinical Psychology*, *70*, 356–361.
- Catley, D., Harris, K. J., Okuyemi, K. S., Mayo, M. S., Evan, P., & Ahluwalia, J. S. (2005). The influence of depressive symptoms on smoking cessation among African Americans in a randomized trial of bupropion. *Nicotine and Tobacco Research*, *7*, 859–870.
- Centers for Disease Control and Prevention. (2006). Youth risk behavior surveillance – United States, 2005. *Morbidity and Mortality Weekly Report*, *55*, No. S-55.
- Chassin, L., Presson, C. C., Sherman, S. J., & Edwards, D. A. (1990). The natural history of cigarette smoking: Predicting young-adult smoking outcomes from adolescent smoking patterns. *Health Psychology*, *9*, 701–716.
- Coie, J. D., & Dodge, K. A. (1983). Continuities and changes in children's social status: A five-year longitudinal study. *Merrill-Palmer Quarterly*, *29*, 261–282.
- Coie, J. D., & Dodge, K. A. (1988). Multiple sources of data on social behavior and social status in the school: A cross-age comparison. *Child Development*, *59*, 815–829.
- Coie, J. D., & Dodge, K. A. (1998). Aggression and antisocial behavior. In N. Eisenberg (Ed.), *Handbook of Child Psychology* (pp. 779–862). New York: Wiley.
- Conrad, K. M., Flay, B. R., & Hill, D. (1992). Why children start smoking cigarettes: Predictors of onset. *British Journal of Addiction*, *87*, 1711–1724.
- Coyne, J. C. (1976). Toward an interactional description of depressive symptoms. *Psychiatry*, *39*, 28–40.
- Dishion, T. J., Capaldi, D., Spracklen, K. M., & Li, F. (1995). Peer ecology of male adolescent drug use. *Development and Psychopathology*, *7*(4), 803–824.
- Fergusson, D. M., Goodwin, R. D., & Horwood, L. J. (2003). Major depressive symptoms and cigarette smoking: Results of a 21-year longitudinal study. *Psychological Medicine*, *33*, 1357–1367.
- Fergusson, D. M., & Horwood, L. J. (1999). Prospective childhood predictors of deviant peer affiliations in adolescence. *Journal of Child Psychology and Psychiatry*, *40*, 581–592.
- Fontaine, R. G. (2006). Evaluative behavioral judgments and instrumental antisocial behaviors in children and adolescents. *Clinical Psychology Review*, *26*, 956–967.
- Glassman, A. H., Helzer, J. E., Covey, L. S., Cottler, L. B., Stetner, F., Tipp, J. E., et al. (1990). Smoking, smoking cessation, and major depression. *The Journal of the American Medical Association*, *264*, 1546–1549.
- Hankin, B. L., & Abramson, L. Y. (2001). Development of gender differences in depressive symptoms: An elaborated cognitive vulnerability-transactional stress theory. *Psychological Bulletin*, *127*, 773–796.
- Hayford, K. E., Patten, C. A., Rummans, T. A., Schroeder, D. R., Offord, K. P., Croghan, I. T., et al. (1999). Efficacy of bupropion for smoking cessation in smokers with a former history of major depression or alcoholism. *British Journal of Psychiatry*, *174*, 173–178.
- Hitsman, B., Borrelli, B., McChargue, D. E., Spring, B., & Niaura, R. (2003). History of depressive symptoms and smoking cessation outcome: A meta-analysis. *Journal of Consulting and Clinical Psychology*, *71*, 657–663.
- Jessor, R., Donovan, J. E., & Costa, F. M. (1991). *Beyond adolescence: Problem behavior and young adult development*. New York: Cambridge University Press.
- Johnson, E. O., Rhee, S. H., Chase, G. A., & Breslau, N. (2004). Comorbidity of depression with levels of smoking: An exploration of the shared familial risk hypothesis. *Nicotine and Tobacco Research*, *6*, 1029–1038.

- Kandel, D. B., & Davies, M. (1986). Adult sequelae of adolescent depressive symptoms. *Archives of General Psychiatry*, *43*, 255–262.
- Kazdin, A. E. (1990). Assessment of childhood depressive symptoms. In A. M. La Greca (Ed.) *Through the eyes of the child: Obtaining self-reports from children and adolescents*. (pp. 189–233). Needham Heights, MA: Allyn & Bacon.
- Keenan, K., Loeber, R., & Green, S. (1999). Conduct disorder in girls: A review of the literature. *Clinical Child and Family Psychology Review*, *2*, 3–19.
- Kendler, K. S., Neale, M. C., MacLean, C. J., Heath, A. C., Eaves, L. J., & Kessler, R. C. (1993). Smoking and major depression: A causal analysis. *Archives of General Psychiatry*, *50*, 36–43.
- Killen, J. D., Robinson, T. N., Haydel, K. F., Hayward, C., Wilson, D. M., Hammer, L. D., et al. (1997). Prospective study of risk factors for the initiation of cigarette smoking. *Journal of Consulting and Clinical Psychology*, *65*, 1011–1016.
- Kobus, K. (2003). Peers and adolescent smoking. *Addiction*, *98*, 37–55.
- Kodl, M. M., Fu, S. S., Willenbring, M. L., Gravely, A., Nelson, D. B., & Joseph, A. M. (2008). The impact of depressive symptoms on alcohol and cigarette consumption following treatment for alcohol and nicotine dependence. *Alcoholism: Clinical and Experimental Research*, *32*, 92–99.
- Kovacs, M., (1992). *Children's Depressive Symptoms Inventory Manual*. New York: Multi-Health Systems.
- La Greca, A. M., & Fisher, E. B., Jr. (1992). Adolescent smoking. *Pediatric Annals*, *21*, 241–248.
- La Greca, A. M., Prinstein, M. J., & Fetter, M. D. (2001). Adolescent peer crowd affiliation: Linkages with health-risk behaviors and close friendships. *Journal of Pediatric Psychology*, *26*, 131–143.
- Leventhal, A. M., Ramsey, S. E., Brown, R. A., LaChance, H. R., & Kahler, C. W. (2008). Dimensions of depressive symptoms and smoking cessation. *Nicotine and Tobacco Research*, *10*, 507–517.
- Levine, M., & Singer, S. I. (1988). Delinquency, substance abuse, and risk taking in middle-class adolescents. *Behavioral Sciences & the Law*, *6*, 385–400.
- Lewinsohn, P. M. (1974). A behavioral approach to depressive symptoms. In R. J. Friedman, M. M. Katz (Eds.), *The psychology of depressive symptoms: Contemporary theory and research*. Oxford, England: Wiley.
- Lewinsohn, P. N., Rohde, P., & Seeley, J. R. (1998). Major depressive disorder in older adolescents: Prevalence, risk factors, and clinical implications. *Clinical Psychology Review*, *18*, 765–794.
- Lloyd-Richardson, E. E., Papandonatos, G., Kazura, A., Stanton, C., & Niaura, R. (2002). Differentiating stages of smoking intensity among adolescents: Stage-specific psychological and social influences. *Journal of Consulting and Clinical Psychology*, *70*, 998–1009.
- Miller-Johnson, S., Lochman, J. E., Coie, J. D., Terry, R., & Hyman, C. (1998). Comorbidity of conduct and depressive problems at sixth grade: Substance use outcomes across adolescence. *Journal of Abnormal Child Psychology*, *26*(3), 221–232.
- Munafo, M. R., Hitsman, B., Rende, R., Metcalfe, C., & Niaura, R. (2008). Effects of progression to cigarette smoking on depressed mood in adolescents: Evidence from the National Longitudinal Study of Adolescent Health. *Addiction*, *103*, 162–171.
- Nolen-Hoeksema, S., & Girgus, J. S. (1994). The emergence of gender differences in depressive symptoms during adolescence. *Psychological Bulletin*, *115*(3), 424–443.
- Panak, W. F., & Garber, J. (1992). Role of aggression, rejection, and attributions in the prediction of depressive symptoms in children. *Development and Psychopathology*, *4*, 145–165.
- Patton, G. C., Carlin, J. B., Coffey, C., Wolfe, R., Hibbert, M., & Bowes, G. (1998). Depression, anxiety, and smoking initiation: A prospective study over three years. *American Journal of Public Health*, *88*, 1518–1522.
- Patton, G. C., Coffey, C., Carlin, J. B., Sawyer, S., & Wakefield, M. (2006). Teen smokers reach their mid twenties. *Journal of Adolescent Health*, *39*, 214–220.
- Pomerleau, O. F., & Pomerleau, C. S. (1984). Neuroregulators and the reinforcement of smoking: Towards a biobehavioral explanation. *Neuroscience and Biobehavioral Reviews*, *18*, 503–513.
- Quattrocki, E., Baird, A., & Yurgelun-Todd, D. (2000). Biological aspects of the link between smoking and depressive symptoms. *Harvard Review of Psychiatry*, *8*, 99–110.
- Quiggle, N. L., Garber, J., Panak, W. F., & Dodge, K. A. (1992). Social information-processing in aggressive and depressed children. *Child Development*, *63*, 1305–1320.
- Repetto, P. B., Caldwell, C. H., & Zimmerman, M. A. (2005). A longitudinal study of the relationship between depressive symptoms and cigarette use among African American adolescents. *Health Psychology*, *24*, 209–219.
- Rutter, M., & Sroufe, L. A. (2000). Development and psychopathology: Concepts and challenges. *Development and Psychopathology*, *12*, 265–296.
- Sterba, S., Prinstein, M. J., & Cox, M. J. (2007). Developmental trajectories of internalizing problems across childhood: Heterogeneity, external validity, and gender differences. *Development and Psychopathology*, *19*, 345–366.
- Steuber, T. L., & Banner, F. (2006). Adolescent smoking and depression: Which comes first? *Addictive Behaviors*, *31*, 133–136.
- Tram, J. M., & Cole, D. A. (2006). A multimethod examination of the stability of depressive symptoms in childhood and adolescence. *Journal of Abnormal Psychology*, *115*, 674–686.
- U.S. Department of Health and Human Services. (1994). *Preventing tobacco use among young people. A report of the Surgeon General* (DHSS Publication No. S/N017–001–00491–0). Washington, DC: U.S. Government Printing Office.
- Urberg, K. A., Degirmencioglu, S. M., & Pilgrim, C. (1997). Close friend and group influence on adolescent cigarette smoking and alcohol use. *Developmental Psychology*, *33*, 834–844.
- Windle, M., & Windle, R. C. (2001). Depressive symptoms and cigarette smoking among middle adolescents: Prospective associations and intrapersonal and interpersonal influences. *Journal of Consulting and Clinical Psychology*, *69*, 215–226.
- Wu, L., & Anthony, J. C. (1999). Tobacco smoking and depressed mood in late childhood and early adolescence. *American Journal of Public Health*, *89*, 1837–1840.