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Risk and Protective Factors Associated with Trajectories of Depressed Mood from Adolescence to Early Adulthood

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Abstract

This study used semi-parametric group-based modeling to explore unconditional and conditional trajectories of self-reported depressed mood from age 12 to 25. Drawing on data from the National Longitudinal Study of Adolescent Health ($N=11,559$), four distinct trajectories were identified: no depressed mood, stable low depressed mood, early high declining depressed mood, and *late escalating depressed mood*. Baseline risk factors associated with greater likelihood of membership in depressed mood trajectory groups compared to the no depressed mood group included being female, Black/African American, Hispanic/Latino American, or Asian American, lower SES, using alcohol, tobacco, or other drugs on a weekly basis, and delinquent behavior. Baseline protective factors associated with greater likelihood of membership in the no depressed mood group compared to the depressed mood trajectory groups included two-parent family structure, feeling connected to parents, peers, or school, and self esteem. With the exception of delinquent behavior, risk and protective factors also distinguished the likelihood of membership among several of the three depressed mood groups. The results add to basic etiologic research regarding developmental pathways of depressed mood in adolescence and young adulthood.

Keywords

depressed mood trajectories; risk and protective factors; adolescence; longitudinal; person-centered analysis

Introduction

Depression imposes significant personal, medical, and social costs, ranking fourth in terms of its contribution to the global burden of disease (World Health Organization, n.d.). Longitudinal analyses of epidemiological samples suggest that depressive disorders become more common in adolescence (Rutter, 1991). In childhood, the median prevalence of depression is under 2% (Costello et al., 2002). During adolescence and young adulthood, however, the twelve-month prevalence rises to 12.4% for major depression and 7.1% for minor depression (Kessler & Walters, 1998). Developmental processes that may explain this rise in prevalence include puberty-related hormonal changes (Ge, Conger, & Elder, 2001a, 2001b), adolescents' greater capacity for abstract thinking, self-reflection, and rumination associated with cognitive maturation (Nolen-Hoeksema, 1994), and increased psychological stress that may occur as a result of normative developmental transitions (Koenig & Gladstone, 1998) or changing

relationships with parents, peers and romantic partners (Hankin, Mermelstein, & Roesch, 2007). Given the evidence that both major and minor depression first appear in adolescence (Costello, Egger, & Angold, 2005), and that early age at onset predicts longer duration (Kovacs, Feinberg, Crouse-Novak, Paulauskas, & Finkelstein, 1984), adolescence is a critical period for identification, prevention, and intervention.

At the same time, there is substantial variation among adolescents and young adults in both the degree and development of depressive symptoms that may be explained, in part, by unique patterns of risk and protective factors that are salient during this period. Gaining a better understanding of how these risk and protective factors are related to developmental trajectories of depressive symptoms can be useful for providing programs and services aimed at promoting adaptive (or preventing maladaptive) psychological adjustment during adolescence and young adulthood. This work can benefit from understanding (1) patterns of persistence and change (e.g., escalation or remission) in depressed mood over time that may represent different etiological processes, and (2) individual factors associated with the developmental course of depressed mood that are amenable to intervention.

Risk factors associated with higher levels of depressive symptoms in both girls and boys include being African-American, Hispanic, or Asian/Pacific Islander (Wight, Aneshensel, Botticello, & Sepulveda, 2005), lower socioeconomic status (Kandel & Davies, 1982), delinquency or conduct problems (Angold, Costello, & Erkanli, 1999; Kandel & Davies, 1982; Lewinsohn, Roberts et al., 1994; Rohde, Lewinsohn, & Seeley, 1991), cigarette smoking (Brook, Schuster, & Zhang, 2004; Brown, Lewinsohn, Seeley, & Wagner, 1996; Choi, Patten, Gillen, Kaplan, & Pierce, 1997; Galambos, Leadbeater, & Barker, 2004; Goodman & Capitman, 2000), and substance abuse (Lewinsohn, Roberts et al., 1994; Schrier, Harris, Kurland, & Knight, 2003). Factors that appear to have protective effects against depression include higher self esteem (Allgood-Merten & Lewinsohn, 1990; Kandel & Davies, 1982; Lewinsohn, Roberts et al., 1994) and greater school connectedness (Shocet, Dadds, Ham, & Montague, 2006). Social support from parents and peers also buffers adolescents from depression (Galambos et al., 2004; Lewinsohn, Roberts et al., 1994; Windle, 1992), although some studies have reported this association for females but not males (e.g., Gutman & Sameroff, 2004).

Longitudinal studies have adopted different conceptual approaches to measuring depression. Studies that have used diagnostic criteria (e.g., DSM-IV; American Psychiatric Association, 1994) to obtain categorical measures have yielded important findings regarding severity, prevalence, onset, duration, and recurrence of depressive disorders. In a randomly-selected community sample of 9th-12th grade students, the mean age of onset for major depression was around 15 years, lasting for an average of 26.4 weeks, and recurring an average of 21-28 months later (Lewinsohn, Clarke, Seeley, & Rohde, 1994). Mirroring gender differences found among adults, findings from the National Comorbidity Study indicated the estimated twelve-month prevalence of major depression among 15-24-year-olds was 16.1% for females and 9% for males (Kessler & Walters, 1998).

Other studies have used symptoms measures (e.g., CES-D; Radloff, 1977) to examine depression along a continuum of severity that includes both clinical and sub-clinical expression. Overall, these studies have described a pattern of increasing depressive symptoms in mid-adolescence (Cole et al., 2002; Garber, Keiley, & Martin, 2002) followed by decline in late adolescence and early adulthood (Ge, Natsuaki, & Conger, 2006; Gutman & Eccles, 2007). Boys' trajectories of depressive symptoms, however, tended to be relatively stable in contrast to girls' symptom trajectories, which exhibited greater increases over time (Cole et al., 2002; Garber et al., 2002; Ge, Lorenz, Conger, Elder, & Simons, 1994). This research has contributed valuable information toward understanding the developmental course of depression through its characterization of average symptom levels with the population over

time. Yet developmental psychopathology theorists suggest that depressive disorders are best understood as “heterogeneous conditions that are likely to eventuate through a variety of developmental pathways” (Cicchetti & Toth, 1998, p. 221).

In response, researchers have begun integrating person-centered and variable-centered approaches to longitudinal analysis in order to distinguish *multiple* developmental pathways reflecting previously unobserved individual heterogeneity in depressive symptoms. This integrated strategy draws the person to the foreground of the analysis and illuminates the ways in which individual characteristics are organized into meaningful patterns that distinguish subgroups of people (Hart, Atkins, & Fegley, 2003; Magnusson, 1998, 2003). From a clinical perspective, such research also has important implications for evolving strategies aimed at the prevention or reduction of depression symptoms. Universal prevention programs using educative or skill-building techniques with groups of adolescents, regardless of need, have generally failed to demonstrate high efficacy or effectiveness (Spence & Shortt, 2007). Therefore, increasing attention has been turned to strategies that target subgroups of the population based on their exposure to specific risk factors or the presence of sub-clinical symptoms of depression. Although these selective or indicated approaches have been shown to be more effective than universal programs (Horowitz & Garber, 2006), they require precise knowledge of risk and protective factors and of patterns in the expression of depressive symptoms. By linking risk and protective factors to different depressed mood trajectories, a combined person- and variable-centered analysis strategy may therefore inform the development of intervention and prevention programs that are tailored to different subgroups within the broader population (Bates, 2000).

One flexible framework for conducting such an integrated analysis is provided by a semi-parametric group-based modeling approach (Jones, Nagin, & Roeder, 2001; Nagin, 1999, 2005). A category of finite mixture models, this technique was developed to identify population subgroups following distinct developmental trajectories (Muthén & Muthén, 2000; Nagin, 1999). In contrast to conventional growth modeling, which “assumes that the population distribution of trajectories varies continuously across individuals,” group-based trajectory modeling “assumes that there may be clusters or groupings of distinctive developmental trajectories that themselves may reflect distinctive etiologies” (Nagin & Tremblay, 2005, p. 84). This methodological approach permits the empirical identification of trajectories that may reflect unique etiologies of depressive symptoms that diverge from the average trajectory that describes the population.

Support for the plausibility of distinct trajectory groups comes from previous studies that have used person-centered techniques to identify patterns of depressive symptoms over time. These studies have reported evidence for three (Rodriguez, Moss, & Audrain-McGovern, 2005) and four (Brendgen, Wanner, Morin, & Vitaro, 2005; Repetto, Caldwell, & Zimmerman, 2004; Stoolmiller, Kim, & Capaldi, 2005) trajectory groups. Trajectory groups that were common across these studies were characterized by (1) *consistently low* and (2) *consistently high* depressive symptoms. Other trajectory groups showed *consistently moderate, increasing*, (Brendgen et al., 2005; Repetto et al., 2004) and *decreasing* (Repetto et al., 2004; Stoolmiller et al., 2005) depressive symptoms.

Although it is difficult to make direct comparisons across these studies due to differences in their methods (e.g., how they measured depressive symptoms, age at initial assessment and length of follow-up), analytic techniques (e.g., cluster analysis, semi-parametric group-based modeling, latent growth mixture modeling), and sample characteristics (e.g., urban versus suburban, racially-ethnically diverse versus homogeneous, and high risk versus community samples), taken together, these findings suggest that there is a fair amount of heterogeneity in

depressive symptoms across adolescence and young adulthood that may be modeled by integrating variable- and person-centered approaches to analyzing developmental trajectories.

Building upon existing research that has mapped a variety of prototypical trajectories characterizing common patterns of depressive symptoms, our study aimed to extend this work in the following ways: (1) by using a nationally representative sample, we sought to discover whether previously identified trajectory groups were characteristic of the general population of U.S. adolescents, (2) by following adolescents from early adolescence (when the prevalence of depressive disorders increases) into early adulthood, we included the most informative age group for mapping continuity and discontinuity in depressed mood over time, and (3) by incorporating into our analysis empirically derived risk and protective factors for depressive symptoms that may aid the development of targeted prevention and intervention programs, we evaluated whether they were associated with individuals' propensity to follow a particular trajectory.

Method

Participants

The data for this analysis were drawn from the National Longitudinal Study of Adolescent Health (Add Health), a nationally representative, probability-based survey examining a broad range of health-related attitudes and behaviors of U.S. adolescents who were in grades 7 through 12 between September 1994 and April 1995 (Chantala, 2003). From a primary sampling frame of all high schools in the United States with an 11th grade and at least 30 students, a systematic random sample of 80 high schools was selected proportional to enrollment size, and stratified by geographic region, urbanicity, school type (i.e., public, private, parochial), and ethnic mix. Fifty-two "feeder" schools that sent their students to those high schools without 7th or 8th grades were randomly selected proportional to the percent of their contribution to the high school's entering class. Up to three rounds of data are available for 10 age cohorts (born between 1974 and 1983). At Wave 1, a confidential in-school self-administered questionnaire was given to all students in grades 7 through 12 who were in school on the day of the survey. A representative sample of 12,105 students (stratified by grade and gender) was randomly selected from the more than 90,000 students who completed the in-school survey, and these students participated in a 90-minute in-home interview between April and December 1995. A second round of interviews (Wave 2) was conducted with the Wave 1 participants one year later. The third round of interviews (Wave 3) was conducted five years later, between 2001 and 2002.

The Add Health study collected up to three rounds of data from adolescents in multiple overlapping age cohorts. This approach provided an opportunity to examine developmental trajectories spanning early adolescence to young adulthood by "linking" the cohorts together based on age in a *cohort-sequential design* (see Miyazaki & Raudenbush, 2000; Willett, Singer, & Martin, 1998 for details). We excluded 15 participants from the core sample of 12,105 who were younger than age 12 at Wave 1 or older than age 26 at Wave 3 because they were too few in number to be representative of their respective age cohorts. Nine participants were missing depressed mood outcome measures at all assessment points and were not included in our analysis. As is true of conventional growth models, group-based trajectory models cannot accommodate cases with missing covariates, so 522 participants were set aside for this reason. We considered data imputation as an alternative to excluding these cases, however typical strategies for handling missing data (e.g., multiple imputation) may not be appropriate in this situation, as their assumption of a single population is at odds with the group-based trajectory modeling approach's hypothesis of multiple subgroups within a population (Colder et al., 2001). We conducted our analysis with the remaining 11,559 participants with complete data.

Procedure

During the in-home survey, an interviewer read the questions aloud and recorded the respondent's answers using a laptop computer-assisted personal interview (CAPI) system. Portions of the survey pertaining to potentially sensitive information (e.g., questions about suicidality and substance use) were administered using an audio computer-assisted self-interview (ACASI) that allowed the participants (rather than the Add Health interviewer) to enter their responses directly into the computer.

Measures

Age—We calculated adolescents' age in years at Wave 1 by subtracting their birth date from their interview date. At Waves 2 and 3, Add Health provided a calculated age variable. However, the value of the Wave 2 age variable was incorrect for 24 adolescents, and we calculated their age following the same method used at Wave 1. We centered age by subtracting 19.25 from each observed value so the model intercept would have a meaningful value (i.e., average depressed mood score at the approximate midpoint of the developmental period under study) (Singer & Willett, 2003) and to reduce collinearity among the variables in the model (Cohen, Cohen, West, & Aiken, 2003). The sample mean ages were 15.99 (SD=1.74), 15.98 (SD=1.61) and 21.74 (SD=1.77) across the three data collection waves.

Race-ethnicity—Logic suggested by Add Health researchers¹ guided our creation of an indicator of race-ethnicity based on the six non-mutually exclusive choices offered in the Wave 1 in-home survey. The order of precedence for determining the value of the race-ethnicity indicator was: Hispanic/Latino American (11.85%), Black/African American (18.83%), Pacific Islander/Asian American (4.20%), Native American/Other (3.11%), and non-Hispanic/Latino White (61.79%). For example, if adolescents said they were Hispanic/Latino American, Pacific Islander/Asian American, and Native American/Other, we coded their race-ethnicity indicator as Hispanic/Latino American. Non-Hispanic/Latino White participants served as the reference group in the trajectory models.

Gender—The Wave 1 measure of biological sex was coded with values of 0 for males (47.63%) and 1 for females (52.37%).

SES—Resident parent's highest level of education at Wave 1 was used as a proxy measure of socioeconomic status. In cases where mother's education was missing, we substituted father's education. Parent education was recoded to reflect the following categories: (1) less than high school or not known (18.32%), (2) high school, GED, business, trade, or vocational school (35.99%), (3) some college, business, trade, or vocational secondary school (19.31%), (4) college or university graduate (18.5%), and (5) professional training beyond a 4-year college or university (7.88%).

Delinquent behavior—Involvement in delinquent behavior was assessed at Wave 1 with eleven questions asking the adolescents whether they had engaged in a variety of delinquent acts (e.g., painted graffiti, deliberately damaged property, lied to their parents, stole from a store, ran away from home, drove a car without the owner's permission). We followed the guidelines of the Add Health investigators and computed a mean score ($\alpha = 0.78$) for each respondent (Resnick et al., 1997). In this sample, values ranged from 0 to 10.91, with a mean of 0.39 (SD=0.76).

¹See <http://www.cpc.unc.edu/projects/addhealth/data/using/code/race#1227>.

ATOD use—Wave 1 items measuring frequency of alcohol, tobacco, and marijuana use were moderately correlated (i.e., correlation coefficients ranged from 0.28 to 0.40). Because of these moderate inter-correlations and to minimize the number of cases lost due to missing data, we created a composite baseline indicator of weekly alcohol, tobacco, or marijuana use. This variable was set to 1 if adolescents indicated they (a) drank alcohol on 1-2 days or more per week in the last 12 months, (b) smoked cigarettes on 5 or more days in the past month, or (c) used marijuana 4-5 days or more in the past month; otherwise, it was set to 0. Approximately one-quarter of the adolescents (26.3%) reported ATOD use at the baseline interview.

Family structure—Wave 1 household rosters provided information on whether adolescents lived with one or both parents (i.e., biological parent, step-parent, or parent figure). Most adolescents (74.3%) reported living in a two-parent household.

Connection—At Wave 1, two items assessed the extent to which adolescents felt parents and friends cared about them (1=not at all, 5=very much). Five items measured connection to school (e.g., feeling comfortable, secure, or belonging; 1=strongly agree, 5=strongly disagree). We reversed coded the school connection items so that higher values reflected greater connection and calculated a mean school connection score. As the parent, friend, and school connection items were moderately correlated (i.e., correlation coefficients ranged from 0.17 to 0.26), we created a composite measure by computing the mean of the three items ($\alpha=0.45$). In this sample, values ranged from 1 to 5, with a mean of 4.26 (SD=0.49).

Self esteem—Six items assessed feelings of self-worth and acceptance (e.g., “I have a lot of good qualities,” “I like myself just the way I am”; 1=strongly agree, 5=strongly disagree). We reverse coded the items so that higher values indicated greater self esteem, and calculated the mean of the six items to create a summary measure of self esteem ($\alpha = 0.85$). In this sample, values ranged from 1 to 5, with a mean of 4.12 (SD=0.59).

Depressed mood—Depressed mood was measured using three items indicating how often in the past week adolescents had felt sad, depressed, or could not shake off the blues (0 = “never or rarely,” 3 = “most of the time or all of the time”). Responses were summed to create a composite score for each adolescent that ranged from 0 to 9 ($\alpha = 0.80$). In this sample, the mean values at each wave were 1.46 (SD=1.80), 1.46 (SD=1.80), and 1.15 (SD=1.67). We had several reasons for selecting this 3-item measure of depressed mood. First, the face validity of the items suggested they tapped key components of depressed mood. Second, the items were drawn from the Depressed Affect scale of the CES-D (Radloff, 1977). Third, the composite measure had acceptable internal reliability, as measured by Cronbach’s α . Fourth, a confirmatory factor analysis conducted with data from Wave 1 yielded a five-item measure of depression that was psychometrically equivalent across adolescents from eleven different multiethnic groups and different immigrant generations (Perreira, Deeb-Sossa, Harris, & Bollen, 2005); of the five items, only these three were collected during all waves of the Add Health study. Finally, in the context of latent variable modeling, Little and colleagues pointed out that “three indicators of a construct lead to a just-identified latent variable,” which they argue is superior to a latent variable measured with more indicators because it “has only one unique solution that optimally captures the relations among the items” (2002, p. 162).

Analytic Strategy—We used a semi-parametric group-based method (Jones et al., 2001; Nagin, 1999, 2005) to empirically identify depressed mood trajectories from ages 16 to 25. This approach is an appropriate method for answering the questions that motivated our analysis on a number of grounds. In addition to enabling us to examine multiple trajectories of depressed mood, it permits the shape of the trajectory (e.g., linear, quadratic, cubic) to vary across groups (Nagin, 2005), facilitating our investigation of complex patterns of change. This method is also

capable of estimating trajectory functions for a variety of variable distributions, which allowed us to specify a censored normal model that was appropriate for the distribution of our outcome measure. Finally, it accommodates the inclusion of predictors of the probability of trajectory group membership in the model (Nagin, 2005), which was a key element of our analysis. We estimated the trajectory models with a user-written SAS procedure, PROC TRAJ (Jones et al., 2001). We included sample weights to account for the Add Health study's design effects and to obtain parameter estimates that reflect accurately the population of interest (see Chantala & Tabor, 1999 for details).

Because we were interested in exploring trajectories of depressed mood from a developmental perspective, we used chronological age (rather than data collection wave) to measure time in this analysis. However, as the assessments were not equally spaced and cases were missing at Waves 2 and 3, we created age categories that spanned two (i.e., ages 12-13, 14-15, 16-17, 18-19, 20-21) or four (22-25) years to improve data coverage.

We relied on several recommended criteria to assess model fit (Nagin, 1999,2005). The Bayesian Information Criteria (BIC) is a standard measure for deciding whether additional classes or predictors of trajectory group membership result in a better fitting model. Although definitive thresholds have yet to be established, the model with the larger BIC value is generally favored. Under some circumstances, however, the BIC value continues to increase as more groups are added (see Nagin, 2005, pp. 74-77 for a detailed explanation), leading to less parsimonious models that are difficult to interpret. For that reason, we considered additional criteria to guide our selection of the final model. The posterior probabilities of group membership “collectively measure a specific individual's likelihood of belonging to each of the model's J trajectory groups” (Nagin, 2005, p. 78), and provide another measure of how well the estimated model fits the observed data. Ideally, individuals' posterior probabilities equal 1 for their most likely trajectory group and 0 for the remaining trajectory groups, however a minimum average posterior probability of .70 for all trajectory groups is considered evidence of acceptable model fit (Nagin, 2005). The odds of correct classification (OCC) assess the model's assignment accuracy and simulation studies suggest OCC values greater than 5 for all trajectory groups indicate high accuracy in group assignments (Nagin, 2005). A reasonably close match between the estimated group probabilities ($\hat{\pi}_j$) and the proportion of the sample assigned to each group based on the maximum posterior probability assignment rule (P_j) is yet another characteristic of adequate model fit (Nagin, 2005). Finally, we were guided by previous research in deciding whether the selected model was interpretable from a substantive and theoretical standpoint.

Results

Estimating an unconditional trajectory group model

Initially, we estimated separate models for female and male participants to investigate possible discrepancies in the number or shape of the trajectory groups. As we found no appreciable differences, we estimated all models with the full sample and report those results. Previous research led us to expect that we would find three or four trajectory groups in this sample. Although the 5-group model (Table 1) had the largest BIC value (-41114.33), the other diagnostic criteria we took into account (Table 2) suggested that the 4-group model represented a better fit to the data than the other models we estimated. We also evaluated the 4-group model in terms of its substantive interpretability. The fitted model described distinct trajectories that were in line with those identified by previous research and that reflected theoretically meaningful patterns of depressed mood. Based on these collective criteria, we selected the 4-group model as our final unconditional model. The predicted trajectories are depicted in Figure 1. The *no depressed mood* group (an estimated 28.7% of the population) followed a quadratic

trajectory showing a slight increase in mid-adolescence followed by a decline around age 20. The *stable low depressed mood* group represented the largest group in the sample (an estimated 59.4% of the population) and followed a constant (intercept-only) trajectory. The *early high declining depressed mood* group (an estimated 9.4% of the population) followed a quadratic trajectory characterized by relatively high depressed mood from early to mid-adolescence, followed by a steady decline over time. The *late escalating depressed mood* group (an estimated 2.4% of the population) displayed levels of depressed mood similar to the *no depressed mood* group in early adolescence, which shifted to a pattern of increasing depressed mood into early adulthood that reflected quadratic change.

Estimating a conditional trajectory group model

The 4-group model with covariates allowed us to examine the associations between the probability of trajectory group membership and the selected risk and protective factors while simultaneously estimating the parameters that defined the trajectory groups themselves. We used measures from Wave 1 to establish a temporal order between the predictors and the depressed mood trajectories that formed the outcome (Nagin, 2005). Adding demographic characteristics (i.e., gender, race-ethnicity, and SES), risk (i.e., ATOD use, delinquent behavior) and protective factors (i.e., family structure, connection to parents, peers, and school, and self esteem) further improved the model fit (Table 1, BIC = -36957.13). The addition of these covariates also rendered non-significant the (a) linear and quadratic terms for the *no depressed mood* group and (b) the quadratic term for the *late escalating depressed mood* group, which we removed from the model. We tested for possible interactions suggested by previous studies (e.g., to examine whether associations between depressed mood and the risk and protective factors varied as a function of gender or race-ethnicity). Adding these parameters did not improve the model fit, however, and were not retained.

We fitted a series of multinomial logistic regression models in which we varied the reference group. The estimated odds ratios (OR) and 95% confidence intervals presented in the following section describe the odds of trajectory group membership relative to the reference group that were associated with the baseline measures in the model.

Stable low depressed mood versus no depressed mood—Participants who were female (OR, 2.63; 95% CI, 2.06-3.36), Black/African American (OR, 1.77; 95% CI, 1.30-2.42), Asian American (OR, 2.21; 95% CI, 1.22-3.99), or reported higher levels of delinquent behavior (OR, 2.91; 95% CI, 1.35-6.28) were more likely to be classified in the *stable low* depressed mood group versus the *no* depressed mood group. Participants from two parent households (OR, 0.76; 95% CI, 0.59-0.99), who reported greater connection to parents, peers, or school (OR, 0.67; 95% CI, 0.51-0.88), higher self esteem (OR, 0.45; 95% CI, 0.35-0.58) or SES (OR, 0.91; 95% CI, 0.83-0.99) were less likely to be classified in the *stable low* depressed mood group versus the *no* depressed mood group.

Early high depressed mood versus no depressed mood—Participants who were female (OR, 8.86; 95% CI, 6.31-12.44), Black/African American (OR, 3.64; 95% CI, 2.43-5.46), Hispanic/Latino American (OR, 2.02; 95% CI, 1.24-3.30), Asian American (OR, 2.63; 95% CI, 1.27-5.44), reported higher levels of delinquent behavior (OR, 3.14; 95% CI, 1.47-6.78) or ATOD use (OR, 3.24; 95% CI, 2.21-4.73) were more likely to be classified in the *early high* depressed mood group versus the *no* depressed mood group. Participants from two parent households (OR, 0.54; 95% CI, 0.39-0.76), who reported greater connection to parents, peers, or school (OR, 0.32; 95% CI, 0.22-0.46), higher self esteem (OR, 0.07; 95% CI, 0.05-0.11) or SES (OR, 0.75; 95% CI, 0.65-0.87) were less likely to be classified in the *early high* depressed mood group versus the *no* depressed mood group.

Late escalating depressed mood versus no depressed mood—Participants who were female (OR, 4.09; 95% CI, 2.08-8.05) or reported higher levels of delinquent behavior (OR, 2.76; 95% CI, 1.24-6.13) were more likely to be classified in the *late escalating* depressed mood group versus the *no* depressed mood group. Participants from two parent households (OR, 0.46; 95% CI, 0.26-0.81), who reported higher self esteem (OR, 0.32; 95% CI, 0.11-0.93) or SES (OR, 0.73; 95% CI, 0.54-0.97) were less likely to be classified in the *late escalating* depressed mood group versus the *no* depressed mood group.

Early high depressed mood versus stable low depressed mood—Participants who were female (OR, 3.36; 95% CI, 2.39-4.75), Black/African American (OR, 2.06; 95% CI, 1.39-3.04), or reported higher levels ATOD use (OR, 2.59; 95% CI, 1.86-3.61) were more likely to be classified in the *early high* depressed mood group versus the *stable low* depressed mood group. Participants from two parent households (OR, 0.71; 95% CI, 0.54-0.95), who reported greater connection to parents, peers, or school (OR, 0.48; 95% CI, 0.36-0.63), higher self esteem (OR, 0.16; 95% CI, 0.11-0.22) or SES (OR, 0.83; 95% CI, 0.73-0.94) were less likely to be classified in the *early high* depressed mood group versus the *stable low* depressed mood group.

Late escalating depressed mood versus stable low depressed mood—There were no significant differences between these two trajectory groups with respect to the predictors in the model.

Late escalating depressed mood versus early high depressed mood—Participants with higher self esteem (OR, 4.45; 95% CI, 1.31-15.15) were more likely to be classified in the *late escalating* depressed mood group versus the *early high* depressed mood group. Participants who were female (OR, 0.46; 95% CI, 0.22-0.98) or reported higher levels of ATOD use (OR, 0.47; 95% CI, 0.23-0.94) were less likely to be classified in the *late escalating* depressed mood group versus the *early high* depressed mood group.

Discussion

Previous longitudinal research has described a pattern of increasing depressive symptoms in mid-adolescence (Cole et al., 2002; Garber et al., 2002) followed by decline in late adolescence and early adulthood (Ge et al., 2006; Gutman & Eccles, 2007). However, assuming a common change trajectory for depressive symptoms may be limiting (Raudenbush, 2001), particularly in light of recent evidence suggesting the presence of *multiple* developmental pathways (Brendgen et al., 2005; Repetto et al., 2004; Rodriguez et al., 2005; Stoolmiller et al., 2005). The goals of our analysis were to identify distinct trajectories of depressed mood spanning adolescence and early adulthood, and to extend previous research by examining risk and protective factors associated with the propensity to follow particular trajectories in a representative sample of U.S. adolescents. In terms of our first goal, we observed evidence of heterogeneity in longitudinal patterns of depressed mood that, in our analysis, was best described by four trajectory groups that were consistent with previous research: (1) *no depressed mood*, (2) *stable low depressed mood*, (3) *early high declining depressed mood*, and (4) *late escalating depressed mood*. In line with developmental theory suggesting that most individuals experience relatively low levels of psychological distress during the transition from adolescence to young adulthood (Steinberg, 2005), an estimated 88% of the population were classified in the *no* or *stable low* depressed mood groups. However, during the peak years of severity, the *early high declining* and *late escalating* groups experienced depressed mood levels that were three to five times greater than the *stable low* group. The *early high declining* depressed mood group characterized an estimated 9.4% of the population, but appeared to reflect a trajectory that was indistinguishable from the *stable low* depressed mood group by early adulthood. This finding was consistent with conventional growth modeling results (Ge

et al., 2006; Gutman & Eccles, 2007) and with findings from the only other mixture modeling analysis we were aware of that followed participants into early adulthood (Stoolmiller et al., 2005). A more worrisome pattern characterized the *late escalating* group, whose level of depressed mood resembled that of the *no* depressed mood group in early adolescence, but climbed steadily into young adulthood.

We sought to explain these diverse patterns by investigating the relationship between the odds of trajectory group membership and risk and protective factors that earlier research suggested were related to depressed mood. Echoing gender differences that have been commonly reported (Angold, Erkanli, Silberg, Eaves, & Costello, 2002; Cyranowski, Frank, Young, & Shear, 2000; Garber et al., 2002; Nolen-Hoeksema, Larson, & Grayson, 1999; Wade, Cairney, & Pevalin, 2002; Wang, 2006), we found females were more likely than males to follow any elevated depressed mood trajectory. Explanations offered for gender discrepancies in adolescent depressive symptoms have pointed to differences in how these symptoms manifest (i.e., as internalizing or externalizing behavior) (Kandel & Davies, 1982), gender-specific coping styles (Nolen-Hoeksema, 2001) and reactivity to negative life events (Cyranowski et al., 2000; Hankin et al., 2007), gender differences in puberty-related hormonal changes (Angold & Costello, 2006), or the interaction between gender-linked risk factors and the multiple physical and psychosocial challenges inherent to the adolescent transition (Nolen-Hoeksema, 1994; Nolen-Hoeksema & Girgus, 1994). Other authors have noted that gender differences are already apparent in early adolescence (Angold & Rutter, 1992; Cole et al., 2002; Costello, Mustillo, Erkanli, Keeler, & Angold, 2003; Galambos et al., 2004) and may be moderated by age, with the largest gap between males and females occurring in middle adolescence (Hankin et al., 1998). Thus, it would be important for future research to include participants younger than age 12 in order to capture the period during which gender differences are likely to emerge (Lewinsohn, Hops, Roberts, Seeley, & Andrews, 1993).

Consistent with previous findings (Wight et al., 2005), racial and ethnic differences in depressed mood were also noted. Compared to the *no* and *stable low* depression group, Black/African Americans, Hispanic/Latino Americans, and Asian Americans were more likely to be classified in the *early high declining* depressed mood group, whereas no racial or ethnic differences emerged in comparison with the *late escalating* depressed mood group. Other baseline risk factors that were associated with higher odds of membership in all three depressed mood trajectory groups compared to the *no* depressed mood group that were in line with past research included low SES (Kandel & Davies, 1982) and engaging in delinquent behavior (Angold et al., 1999; Kandel & Davies, 1982; Lewinsohn, Roberts et al., 1994; Rohde et al., 1991). Compared to the other trajectory groups, members of the *early high declining* depressed mood group were more likely to report baseline ATOD use. Lewinsohn and colleagues (Lewinsohn, Roberts et al., 1994) found that current smoking rate and past substance abuse disorder were both associated with a diagnosis of major depression, implying the association with less extreme levels of depressed mood may be weak or non-existent.

Baseline protective factors that were associated with higher odds of membership in the *no* depressed mood group compared to the depressed mood trajectory groups included two-parent family structure and self esteem. These results mirror prior research demonstrating an association between parental divorce (Ge et al., 2006), low self esteem (Allgood-Merten & Lewinsohn, 1990; Kandel & Davies, 1982) and depressive symptoms. In line with previous findings of associations between social support (Galambos et al., 2004), school connection (Shocet et al., 2006) and depressive symptoms, adolescents who reported greater feelings of connection to parents, peers, and school were more likely to be classified in the *no* depressed mood group than either the *stable low* or *early high declining* group. Kandel and Davies (1982) found that having close relationships to parents *and* peers (rather than one group to the exclusion of the other) was associated with lower levels of depression among adolescent girls

and boys. We were unable to test this association, however, because our composite measure combined adolescents' reports of connection to parents, peers, and school.

Risk and protective factors that distinguished the probability of membership among the elevated depressed mood trajectories included being female, ATOD use and self esteem. That is, members of the *early high declining* group were more likely to be female, report weekly ATOD use, and have lower self esteem than members of the *stable low* or *late escalating* depressed mood groups.

Given these differences in risk profiles, it is worth noting that, by the end of the developmental period we examined, these four trajectories coalesced to form two distinct pathways, with the *late escalating* group displaying the highest level and the *no, stable low*, and *early high declining* trajectories displaying similar levels of depressed mood. No comparable pattern was noted in previous trajectory analyses that identified a group exhibiting increasing depressive symptoms (Brendgen et al., 2005; Repetto et al., 2004). However, this discrepancy may be due to the fact that our analysis covered a longer developmental period, and it was not until after age 18 that the *late escalating* depressed group diverged markedly from the other three trajectory groups.

From a clinical perspective, the *late escalating* and *early high declining* trajectory groups are of particular concern, given their high levels of depressed mood (albeit at different points in development). Although members of the *early high declining* group were more likely to be female, report greater ATOD use, and have lower self esteem compared to the *late escalating* group, there was considerable overlap in the remaining risk and protective factors associated with these two trajectories. The dynamic nature of risk and protection offers one potential explanation for these results. The factors in our model were measured at baseline and, over time, members of the *late escalating* trajectory may have exhibited increasing risk that was not captured in our analyses. Alternatively, it is possible that the influence of these (or other unmeasured) protective factors that were present in early- or mid-adolescence diminished during the transition to early adulthood (Orlando, Tucker, Ellickson, & Klein, 2004). Taken together, the findings also underscore the multiple needs of adolescents with high levels of depressive symptoms. Most protective factors identified in the trajectory analyses involved the immediate social sphere of adolescents (two-parent family structure, feeling connected to parents, peers, or school). By contrast, risk factors primarily reflected stable demographic categories (lower SES, being female, ethnic minority group membership) or mental health conditions that often co-occur with depression (substance use, delinquent behavior). It is therefore important to note that many of the existing selective prevention programs for depression in adolescents target the effects of a limited number of risk factors. Existing cognitive-behavioral approaches developed to improve coping or social skills (Cecchini, 1997; Gillham, Reivich, Jaycox, & Seligman, 1995; Jaycox, Reivich, Gillham, & Seligman, 1994; Reinecke, Ryan, & DuBois, 1998) may also foster supportive social networks that provide protection from depression. However, different techniques may be useful for addressing the complex mechanisms that coincide with markers of social adversity (Cardemil, Reivich, & Seligman, 2002) or mental disorder in the individual or family (Roosa, Gensheimer, Short, Ayers, & Shell, 1989). In this way, prevention or intervention with members of the identified trajectory groups would likely require integrative approaches targeting risk and protective factors across multiple contexts (Garber, 2006).

Integrating person- and variable-centered approaches in our analysis enabled us to examine how risk and protective factors for depressed mood were organized in meaningful patterns that distinguished subgroups of adolescents and young adults (Hart et al., 2003; Magnusson, 1998, 2003). By incorporating risk and protective factors into the estimated trajectory model, we were able to move beyond descriptive analyses and test hypotheses relating these factors

to the probability of trajectory group membership (Nagin, 2005). The Add Health data set also offers several advantages for addressing the questions examined in this study. The multiple age cohorts allowed us to use a longitudinal cohort-sequential design to estimate trajectories encompassing the most informative developmental period for mapping continuity and discontinuity in depressed mood. Further, Add Health included assessments of empirically derived risk and protective factors for depressed mood that were important elements of our inquiry. Concerning advances in knowledge, many of the reported findings are similar to past research, either in terms of identified risk and protective factors or relative to the nature of specific trajectories. However, the large, representative sampling frame and the prospective design of the Add Health study allow for increased power to detect effects and offer support for the generalizability of previous findings.

The strengths of this study should be considered along with its limitations. While our results lend support to previous research that identified distinct depressed mood trajectories and associated risk and protective factors with the probability of group membership, our analysis has not identified specific processes or mechanisms that might explain the different patterns we observed. Thus, an extension to our study might examine whether these factors set into motion a sequence of events associated with stability or change in depressed mood over time (Compas, Hinden, & Gerhardt, 1995). For example, an adolescent's delinquent behavior might elicit parent or teacher involvement, which could then lead to therapeutic intervention that could alter the developmental course of depressed mood. Further, our findings may not generalize to specific populations not represented by the Add Health study or the measures we used (e.g., non-school based subpopulations, clinically depressed individuals). In addition, although we considered risk and protective factors that have been previously associated with depressive symptoms, other potential predictors found in the adolescent depression literature (e.g., parental depression history, adolescents' emotional reactivity, anxiety, stress exposure) were not available in this data set. A further limitation is that measures of puberty onset or timing that previous studies have linked to the development of depressive symptoms (Ge, Conger, & Elder, 1996; Ge et al., 2001a, 2001b; Ge et al., 2003) were absent from our analyses. One marker of pubertal status for females is onset of menstruation. In our analytic sample, however, 91% of the female participants had reached this milestone by Wave 1. For males, no comparable measure of pubertal status was available. Alternatively, we considered using adolescents' perception of their physical development relative to that of their same-aged peers as a measure of pubertal timing, however the modal response for both females and males was "I look about average." Although population-based surveys such as Add Health require a difficult balance between inclusiveness of measures and feasibility, the psychometric qualities of specific instruments may be reduced relative to other assessment options. Finally, although we selected an analytic method that was appropriate for answering the questions we posed, other methods (e.g., survival analysis) would be suitable for modeling discontinuous patterns of onset, recurrence, and remission in depressive symptoms (Garber et al., 2002).

Overall, these findings add to basic etiologic research regarding developmental pathways of depressed mood in adolescence and young adulthood, as well as the prospective association of different patterns of risk and protective factors with the probability of trajectory group membership. Our results may be most informative for targeting intervention before the onset of or during the initial periods of risk for depressed mood. Future research incorporating into the trajectory model characteristics that might change during the transition from adolescence to early adulthood, that have the potential to influence depressed mood and alter the trajectories we observed would be a logical extension to this analysis. Such an approach will contribute to the development of intervention and prevention programs that are tailored to different subgroups within the broader population of adolescents and young adults.

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Table 1

Bayesian information criteria for a series of non-parametric group-based models of depressed mood

Model	Bayesian information criterion
Two groups	-41362.76
Three groups	-41220.46
Four groups	-41173.44
Five	-41114.33
Four groups (including covariates)	-36957.13

Table 2

Diagnostics of assignment accuracy for a series of unconditional non-parametric group-based models of depressed mood

Description	$\hat{\pi}_j$	P_j	Ave. PP	OCC
2-group model				
Low stable depressed mood	0.60	0.62	0.82	2.99
High stable depressed mood	0.40	0.37	0.78	5.27
3-group model				
No depressed mood	0.14	0.16	0.61	9.25
Low stable depressed mood	0.75	0.77	0.88	2.36
High stable depressed mood	0.11	0.07	0.76	26.10
4-group model				
No depressed mood	0.29	0.26	0.71	6.11
Stable low depressed mood	0.59	0.67	0.77	2.22
Early high declining depressed mood	0.09	0.06	0.71	24.04
Late escalating depressed mood	0.02	0.01	0.76	125.41
5-group model				
No depressed mood	0.15	0.19	0.63	9.38
Stable low depressed mood	0.71	0.72	0.87	2.75
High declining depressed mood	0.01	0.01	0.67	137.52
Moderately high stable depressed mood	0.10	0.07	0.70	21.76
Late escalating depressed mood	0.02	0.01	0.73	126.49