Heterogeneous trajectories of depressive symptoms: Adolescent predictors and adult outcomes

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Abstract

Background—Depressive symptoms display heterogeneous trajectories across adolescence and early adulthood. Identifying risk and protective factors for distinct trajectory groups, and their respective outcomes, may provide insight into the etiological underpinnings of different symptom courses and inform the targets and timing of intervention.

Methods—A school-based sample of 719 adolescents completed four diagnostic evaluations and up to 7 annually mailed questionnaires assessing psychiatric symptoms and psychosocial risk and protective factors. Parental history of psychiatric disorder was assessed. Growth mixture modeling (GMM) was used to identify latent depressive symptom trajectories from mid-adolescence through age 30, as well as their predictors in mid-adolescence and adult outcomes.

Results—A three class model consisting of high stable (32%), moderate decreasing (44%), and low decreasing (24%) depressive symptom trajectories emerged as the preferred solution. Demographic, psychosocial, and psychiatric characteristics differentiated the low and high symptom classes, and provided support for interpersonal models of depression chronicity. Members of the moderate and high symptom classes evidenced the worst psychosocial and psychiatric outcomes by age 30, with members of the high symptom class showing the greatest levels of impairment.

Limitations—Cross-sectional measurement and floor effects of several predictor variables may have obscured the relations between those predictors and trajectory class membership.

Conclusion—These findings suggest that prevention and intervention strategies may specifically target young women and those who experience poor interpersonal functioning in an effort to alter the course of depressive symptoms through early adulthood.

Keywords

Depression; Trajectories; Adolescence; Emerging adulthood; Growth mixture model

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1. Introduction

Depression is a highly prevalent and impairing condition (Kessler et al., 2003). The onset of major depressive disorder (MDD) increases rapidly in adolescence and early adulthood (Hankin et al., 1998), making these critical periods to focus on the etiology and developmental course of depression. The general trajectory of depressive symptoms increases in early and middle adolescence and then decreases through early adulthood (Ge et al., 1994, 2006; Hankin et al., 1998; Pettit et al., 2010). A growing body of evidence is consistent with heterogeneity in the course of depressive symptoms, which is manifested by multiple subgroup trajectories within the general trajectory (Brendgen et al., 2005; Costello et al., 2008; Repetto et al., 2005; Rodriguez et al., 2005; Stoolmiller et al., 2005).

The identification of distinct trajectories of depressive symptoms may lead to more effective ways to prevent and treat depression. Knowledge of which adolescents are most likely to experience elevated symptom courses, as well as which courses lead to the greatest levels of impairment, would permit a more accurate identification of high-risk groups. Better understanding of the developmental timing of symptom increases and decreases would provide useful information for planning the timing of prevention and intervention efforts. Furthermore, the identification of trajectory-specific risk and protective factors may provide insight into the etiological underpinnings of different symptom courses. In conjunction, this information may allow clinicians to make more informed decisions about the intended recipients, therapeutic targets, and timing of their prevention and intervention efforts.

Several studies have examined heterogeneity in depressive symptom trajectories among adolescents and young adults. Among young adolescents (Brendgen et al., 2005) and high school students (Repetto et al., 2005; Rodriguez et al., 2005), stable high and stable low classes have been identified consistently, and some studies have identified stable moderate or increasing trajectory classes. Predictors of membership in elevated trajectory classes in adolescence include female gender, anxious symptoms, low self-esteem, high stress, and poor relationship quality with parents (Brendgen et al., 2005; Repetto et al., 2005).

A few studies have examined trajectory classes of depressive experiences from adolescence into emerging adulthood. Among 206 men from ages 15–24 years, Stoolmiller et al. (2005) identified four depressive symptom classes corresponding to very low, moderate decreasing, high decreasing, and high persistent. Predictors of membership in the high persistent class included lower family income, lower childhood academic achievement, higher childhood depressive symptoms, higher negative life events, and a higher number of changes in parental figures during childhood. Members of the high persistent and high decreasing classes displayed elevated rates of lifetime MDD in emerging adulthood, as compared to members of the moderate and low classes. Two studies (Costello et al., 2008; Wickrama et al., 2009) examined depression trajectories using data from the National Longitudinal Study of Adolescent Health, a nationally representative sample of youth ages 12–19 who were tracked for six years. Costello et al. identified four distinct depressed mood classes consisting of no depressed mood, stable low, early high declining, and late escalating. Significant predictors of elevated depressed mood trajectories included female gender, ethnic minority status, delinquent behavior, and substance use in adolescence. Protective factors that were associated with a decreased likelihood of elevated depressed mood included higher socioeconomic status, residing in a two-parent household, higher perceived social connection, and higher self-esteem. In the same sample, Wickrama et al. constructed four a priori depressive symptom trajectory groups corresponding to chronically high, increasing, decreasing, and consistently low symptom levels. Membership in the elevated classes was associated with ethnic minority status, female gender, and higher levels of

poverty and parental rejection at baseline, and also with higher levels of physical health problems at the final assessment point.

Thus, although all prior studies on the transition from adolescence into emerging adulthood identified four depressive symptom trajectory classes, the nature of the classes differed somewhat across studies. Moreover, past studies have been limited by a small sample size and an exclusive focus on men (Stoolmiller et al., 2005), measurement of depressed mood rather than the spectrum of depressive symptoms (Costello et al., 2008), and little or no data on psychiatric history and adulthood outcomes of trajectory class membership. The absence of data on psychiatric history prevents conclusions about whether significant predictors of class membership may have been artifacts of pre-existing psychiatric disorders.

The primary purpose of the present study was to extend past research in this area by identifying specific classes of depressive symptom trajectories from mid-adolescence through age 30. Based on prior research, we expected to identify trajectory classes corresponding to stable low and stable high symptoms. We also expected to identify a decreasing symptom class based on the decreasing general trajectory of depressive symptoms seen in emerging adulthood. Because some researchers have also identified an increasing trajectory, we expected that might constitute a fourth class in our sample.

A secondary purpose of the present study was to identify adolescent predictors of trajectory class membership and clinically relevant outcomes at age 30 as a function of trajectory class membership. Predictors and outcomes selected for this study fall within four groups listed in Table 1: status attributes; personal and cognitive resources or stressors; social resources or stressors; and personal and parental psychiatric history. Each predictor was selected on the basis of prior research or theory linking it to elevated depressive symptoms and was therefore expected to differentiate the lowest severity trajectory class from higher severity trajectory classes. Multiple studies have found that female gender, impaired social relationships, and low self-esteem significantly distinguished class membership (Costello et al., 2008; Repetto et al., 2005; Wickrama et al., 2009). We expected those findings to replicate in the present study. Based on interpersonal models of depression chronicity (Coyne, 1976; Joiner, 2000; Lewinsohn and Atwood, 1969; Libet and Lewinsohn, 1973; Pettit and Joiner, 2006), in which maladaptive interpersonal behaviors are posited to maintain depressive symptoms over time, we hypothesized that a history of MDD and indicators of poor interpersonal functioning in adolescence would predict membership in a high severity trajectory class even after controlling for predictors from other domains. Finally, we hypothesized that members of a high severity trajectory class would display significantly greater impairment on age 30 outcomes as compared to members of lower severity trajectory classes.

To test these predictions, we applied growth mixture modeling (GMM) to data from the Oregon Adolescent Depression Project (OADP) to jointly examine specific classes of depressive symptom trajectories. Key advantages of the OADP over prior investigations include the extension of data collection through age 30, inclusion of both women and men, the presence of a well-validated measure of depressive symptoms, and the repeated assessment of psychiatric disorders with structured clinical interviews. In addition, a substantially larger array of potential predictors and outcomes of trajectory class membership are available in the OADP than in previous studies.

2. Method

2.1. Participants

OADP probands were randomly selected from high schools in western Oregon. A total of 1709 adolescents (ages 14–18 years; mean age = 16.6) completed an initial (T_1) assessment between 1987 and 1989. Approximately one year later, 1507 (88%) returned for a second evaluation (T_2). Differences between the sample and the larger population from which it was selected, and between participants and those who declined to participate or dropped out of the study before T_2, were negligible (Lewinsohn et al. 1993). At age 24, all adolescents with a history of Axis I psychopathology by T_2 ($n = 644$) and a random sample of adolescents with no history of psychopathology by T_2 ($n = 457$) were invited to participate in a third (T_3) evaluation. Of the 1101 T_2 probands selected for a T_3 interview, 941 (85%) completed the evaluation. At age 30, all T_3 probands were invited to participate in a T_4 evaluation. Of the 941 T_3 probands, 816 (87%) completed the T_4 diagnostic interview. The 816 T_4 probands included 479 (59%) women. Among those invited to T_3 and T_4 assessments, women were more likely than men to complete evaluations, $\chi^2 > 5.99$, p's $< .05$; participation did not differ as a function of other demographic variables or previous diagnoses. In addition to the four major assessment points, probands were asked to complete seven annual questionnaires that included the Center for Epidemiological Studies Depression scale (CES-D; Radloff, 1977). The period covered by the annual questionnaires ran on average from ages 21–28 (mean age at first mailer = 21.53 years, standard deviation = 1.51 years).

Seven-hundred nineteen probands who completed the four major assessments and had data available for all adolescent predictor variables represent the reference sample for this report[1]. Ninety-seven percent of the 719 probands completed at least four annual questionnaires, meaning that data from at least eight assessment points were available for almost all probands. This research was conducted as approved by the institutional review board.

2.2. Psychiatric measures

2.2.1. Depressive symptoms—The CES-D (Radloff, 1977) is a widely-used self-report measure of the frequency of 20 depressive symptoms that has been validated in adolescent and young adult samples (e.g., Roberts et al., 1991; Joiner et al., 2005). The CES-D was completed at up to 10 assessment waves (T_1, T_2, T_4, and seven annual mailers) ($\alpha = .91–.92$).

2.2.2. Proband diagnostic interviews—At T_1, T_2, and T_3, probands were interviewed with a version of the Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS; Orvaschel et al., 1982; Chambers et al., 1985). In conjunction with the K-SADS, the Longitudinal Interval Follow-Up Evaluation (LIFE; Keller et al., 1987) was used to evaluate the presence and course of disorders since participation in the previous diagnostic interview. T_4 diagnostic assessments were based on the Structured Clinical Interview for Axis I *DSM-IV* Disorders—Non-Patient Edition (SCID-NP; First et al., 1995), with the LIFE also used to evaluate disorder presence and course since T_3. Symptom endorsements during these interviews were subsequently evaluated in conjunction with *DSM-III-R* criteria (American Psychiatric Association, 1987) at T_1 and T_2 and *DSM-IV* criteria (American Psychiatric Association, 1994) at T_3 and T_4. Interviews at T_3 and T_4 were

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[1]This group of participants did not significantly differ from the larger sample who completed all four assessment waves ($N = 816$) on any demographic, predictor, symptom, or outcome measure (ps > .10).

conducted by telephone, which generally provides comparable validity to face-to-face interviews (Sobin et al., 1993; Rohde et al., 1997).

2.2.3. Parental diagnostic interview—Lifetime psychiatric disorders in the biological parents of probands were assessed near the time of the T_3 evaluation. Parents were directly interviewed using a version of the non-patient edition of the Structured Clinical Interview for *DSM-III-R* (SCID-NP) that had been modified for *DSM-IV* criteria (Spitzer et al., 1992). Parent history data were collected using the Family Informant Schedule and Criteria (FISC; Mannuzza and Fyer, 1990), supplemented with all items necessary to derive *DSM-IV* diagnoses. Five hundred forty-eight (76%) parents completed the SCID-NP, and psychiatric histories via the FISC were collected on all parents. As multiple data sources were available for most parents, lifetime best-estimate *DSM-IV* diagnoses were derived independently by two senior diagnosticians from all available information (Leckman et al., 1982).

3. Psychosocial predictors assessed in adolescence

An extensive battery of psychosocial measures was administered to probands at T_1 (see Lewinsohn et al., 1994). Several measures of psychosocial functioning were either developed specifically for the purposes of the OADP or were adapted from pre-existing measures of psychosocial functioning. Four scales described below were developed from items administered to the OADP sample at T_1. Past work has supported the single factor structure and internal reliability of each scale (see Mathew et al., 2011).

3.1. Family social support

This construct was measured with eight continuously-scored items. Example items include "How well do you get along with your siblings?" and "How well do you get along with your parents?"

3.2. Friend social support

This construct was assessed with seven continuously-scored items. Example items include "How many close friends do you have?" and "How well do you get along with other kids?"

3.3. Academic problems

This construct was assessed with seven items, such as "How many days of school did you miss over the last 6 weeks?" and "Were you satisfied with your grades?"

3.4. Health problems

This construct was assessed with six items, including "During the past 12 months, have you been treated for any illness, condition, or injury?" and "In the past year, have you been unable to work and/or participate in school activities because of some illness or injury?"

In addition to the four scales developed for the OADP, several well-validated and extensively used measures of psychosocial functioning were included. These measures and their reliability in the OADP sample have been described in detail in previous publications (Andrews et al., 1993; Lewinsohn et al., 1994). A brief description of each construct is given below.

3.5. Coping

Coping skills assessed the ways in which individuals cope with stressful situations, using 17 items originally selected from the self-control scale (Rosenbaum, 1980), the Antidepressive

Activity Questionnaire (Rippere, 1977), modified by Parker and Brown (1979), and the Ways of Coping Questionnaire (Folkman and Lazarus, 1980).

3.6. Dysfunctional attitudes

Intensity of dysfunctional attitudes was assessed with nine items from the dysfunctional attitudes scale (DAS; Weissman and Beck, 1978).

3.7. Interpersonal dependency

The extent to which probands desired more support and approval from others, were anxious about being alone or abandoned, and were interpersonally sensitive was assessed with the emotional reliance subscale of the Interpersonal Dependency Inventory (Hirschfeld et al., 1977).

3.8. Loneliness

The adapted UCLA loneliness scale (Roberts et al., 1993) is an 8-item scale which measures feelings of solitude, disconnection, and lack of closeness.

3.9. Self-esteem

This scale assessed satisfaction with specific body parts (3 items; body parts satisfaction scale; Berscheid et al., 1973), general satisfaction with physical appearance (3 items; physical appearance evaluation subscale; Winstead and Cash, 1984), and global self-esteem (3 items; self-esteem scale, Rosenberg, 1965).

4. Distal outcomes assessed at age 30

At the time of the T_4 assessment (mean age = 30 years), probands were asked to complete a questionnaire that elicited information about marital status, highest level of educational attainment, and household income. Additional constructs assessed at T_4 included the following measures with established reliability and validity in the OADP sample: Coping (described above); Daily Hassles (unpleasant events schedule; Lewinsohn et al., 1985); dysfunctional attitudes (described above); major life events (Andrews et al., 1993); self-esteem (10 items from Rosenberg, 1965); and the social adjustment scale (SAS; Weissman and Bothwell, 1976).

5. Analytic approach

GMM was used to identify classes of depressive symptom trajectories, predictors of class membership, and outcomes of class membership using the statistical software program Mplus, Version 6.1 (Muthén and Muthén, 1998–2010). Given the stratified sampling procedure used at T_3, weights reflecting the probability of selection for the T_3 follow-up were used in analyses. Full Information Maximum Likelihood was used to estimate missing values that were missing at random and comprised on average 4.63% of the sample[2].

Based on visual inspection of raw individual plots and preliminary analyses of single-group trajectory models, a quadratic growth model that specified time scores to assessment waves was fit and used in subsequent analyses, $\chi^2(46) = 154.46$, $p < .0000$; CFI = .96, RMSEA = .06. Class enumeration of the unconditional GMM was conducted through inspection of

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[2]Given the potential for missing data to vary across classes, missing data patterns were re-analyzed using most likely class membership from the 3-class GMM that included predictors and outcomes. Patterns of missing values met the MCAR conditions for Class 1 and Class 2 (Little's MCAR test: Class 1, $\chi^2[838] = 873.03$, $p = .20$; Class 2, $\chi^2[1766] = 1635.39$, $p = .99$), and were found to be MAR for Class 3 (all p-values non-significant after Benjamin–Hochberg correction at $\alpha = .05$).

elbow plots of Bayesian Information Criterion (BIC) and sample-size adjusted BIC (adj. BIC), as well as through Lo–Mendell–Rubin (LMR) and Bootstrap likelihood ratio tests (BLRT) of k and k–1 class solutions (Nylund et al. 2007; Tofighi and Enders, 2008). Lower BIC and adj. BIC values are indicative of better model fit, and less pronounced declines in these values on the elbow plot indicate diminishing gains from estimating additional classes. Growth parameter invariance was tested across classes (Enders and Tofighi, 2008; Morin et al., 2011). Intercept, slope, and quadratic factor variances were fixed to zero values in the first class of models with two or more classes. This constraint was needed to identify growth parameters in the higher classes, and to allow them to freely vary. As was the case for Morin et al. (2011), these equality constraints led the first class to represent the low symptom severity cases, which consisted of probands who never endorsed clinically meaningful levels of depressive symptoms (i.e., CES-D > 16).

5.1. Predictors of class membership

Multinomial logistic regressions were used to identify predictors of trajectory class membership. Unless otherwise stated, the first class that described the low symptom severity group was used as the reference category. All continuous predictors were centered at their respective means to enhance interpretability. Categorical and count predictors retained their original scaling. Given the large number of potential predictors, pseudo-class regressions were first used to winnow down the pool of independent variables (Clark and Muthén, unpublished manuscript). Significant predictors were then entered directly into the GMM model, which allowed for a test of stability of the class solution and causal ordering of the predictors (Marsh et al., 2009). This approach allowed us to retain a high level of power to detect significant effects, without presenting undue bias to regression estimates (Clark and Muthén, unpublished manuscript).

5.2. Outcomes of class membership

Distal outcomes of class membership were entered directly into the model that included predictors of trajectory class membership and were allowed to covary freely within each class. In doing so, the distal outcomes served as indicators of latent trajectory classes, which provided an additional test of the stability of the unconditional GMM (Muthén, 2004). While alternate approaches that test equality of means across latent classes exist (cf. Petras and Masyn, 2010; Morin et al., 2011), their application assumes conditional independence among the outcomes that was not evidenced in our data.

6. Results

6.1. Identification of trajectory classes

Unconditional GMMs that estimated 1–5 classes were examined (see Table 2). Stable solutions were obtained for all but the 5-class model, which failed to converge even after the number of random starts was increased to 4000, and was therefore removed from further consideration. Heywood cases in the form of negative growth factor variances were observed in the second and third class of the 4-class model, and required constraints to zero values in order to reach a positive definite psi matrix.

Inspection of relative fit indices for the 1–4 class models provided mixed findings with regard to the preferred number of classes (see Table 2). While BIC and adj. BIC evidenced diminishing gains in estimating classes beyond a 3-class model, significant LMR and BLRT values indicated preference for the 4-class solution. Given the presence of inadmissible values in the 4-class solution, we retained the three-class solution as the preferred unconditional model. Growth parameters were non-invariant across the second and third

class of the 3-class solution, which supported the need to retain class-specific growth parameters (χ^2 [6] = 127.61, $p < .0001$) Table 3.

The three trajectory classes, displayed in Fig. 1, were labeled high stable ($n = 232$, 32%), moderate decreasing ($n = 314$, 44%), and low decreasing ($n = 173$, 24%). These designations were based on the sign and significance of the intercept and slope parameters. Depressive symptoms decreased sharply across the first two measurement periods for all classes, but subsequently displayed class-specific trends (see Fig. 1). To reduce the influence of the dramatic decrease in depressive symptoms across the first two time points, the data were re-centered from the first assessment wave to the middle assessment wave (wave 5 or year 7 in Fig. 1; cf. Biesanz et al., 2004 for discussion on effects of centering on growth parameters). Re-centering did not change class membership or model fit.

Unconditional GMM results are presented in Table 2. Those in the high stable class began their trajectories at more severe levels of depressive symptoms that remained at higher levels at the middle measurement period than for those in the moderate and low decreasing classes, Wald χ^2 (1) = 8.44–372, $p < .01$–.001. This pattern was also observed between those in the moderate and low decreasing classes, Wald χ^2 (1) = 49.49–171.18, $p < .001$.

Significant differences in slope parameters were found across the classes, Wald χ^2 (2) = 14.85, $p < .001$. Members of the high stable class maintained a steady level of depressive symptoms that did not significantly change over time ($b = -.13$, $p = .15$). Slope parameters for the moderate decreasing and low decreasing classes evidenced negative trajectories that did not significantly differ from one another in magnitude, ($b = -.49$ to -59, $p < .001$, Wald χ^2 [1] = 1.70, $p = .19$). These findings suggest that regardless of initial level of symptom severity in mid-adolescence, depressive symptoms declined during the transition from late adolescence to emerging adulthood ($T_1 - T_2$), but stabilized thereafter for the high stable class. In contrast to the high stable class, depressive symptoms continued to decrease during emerging adulthood for the moderate decreasing and low decreasing classes.

6.2. Adolescent predictors of trajectory class membership

Adolescent risk factors were first tested through pseudo-class regressions within their respective risk/protective factor families (see Table 1). Of the initial 18 predictors, eight remained significant within their respective families. The ten non-significant predictors included age, four personal and cognitive variables (academic impairment, dysfunctional attitudes, health impairment, and self-esteem), two social variables (family support and friend support), and three psychiatric and family history variables (lifetime anxiety disorder, lifetime disruptive behavior disorder, and lifetime parental anxiety disorder). These nine variables were excluded from subsequent analyses.

The eight significant predictors from within-family analyses were retained and entered simultaneously as predictors of latent class membership. As expected, and in support of the validity of the distinction between the three classes, the majority of risk factors significantly predicted membership in the high stable and moderate decreasing classes versus membership in the low decreasing class (see Table 4). Compared to those in the low decreasing class, those in the high stable class were more likely to be women, endorsed lower levels of coping, and reported greater levels of loneliness and interpersonal dependency. Individuals in the high stable class were also more likely than those in the low decreasing class to endorse personal and parental histories of MDD and substance use disorders. The same adolescent risk factors significantly distinguished the moderate decreasing class from the low decreasing class, with exception of gender and parental history of substance abuse, which did not reach statistical significance. Finally, as compared to the moderate decreasing class, members of the high stable class were significantly more

likely to be women, to report more loneliness, and to endorse more interpersonal dependency (at a nonsignificant trend level).

6.3. Distal outcomes of trajectory class membership

Mean scores or prevalence rates on distal outcomes in each trajectory class are presented in Table 5. Members of the high stable and moderate decreasing classes significantly differed from members of the low decreasing class on every outcome. As compared to members of the low decreasing class, those in the high and moderate symptom classes attained a lower level of education, reported lower annual household income, displayed poorer adjustment on each psychosocial measure, and experienced higher numbers of MDD, anxiety, and substance use disorder episodes. Members of the high stable class were also more likely to be separated or divorced than those in the low decreasing class. The same pattern of outcomes emerged when members of the moderate decreasing class were compared to those in the high stable class.

7. Discussion

The purposes of the present study were to identify groups of individuals who share distinct trajectories of depressive symptoms from adolescence through early adulthood and to describe these groups with respect to their predictors in adolescence and their outcomes in early adulthood. Support was obtained for three depressive symptom trajectory classes: low decreasing, moderate decreasing, and high stable. The nature of classes in the present study was similar to that of past work on depressive symptoms (Stoolmiller et al., 2005) and indicated a clear ordering of classes (i.e., at no point did the trajectories of different classes cross one another).

While the number of classes differed somewhat from the four class solution retained by others (i.e., Costello et al., 2008; Stoolmiller et al., 2005; Wickrama et al., 2009), this may be due to differences in sample characteristics and approaches to growth parameter specifications. For instance, in contrast to findings on stability of depressive symptoms, the nature of trajectory classes in studies that have assessed depressed mood (Repetto et al., 2005; Costello et al., 2008) reflects greater liability over time and unordered classes (i.e., trajectories of different classes crossed each other). In spite of these discrepancies, every study to our knowledge has found evidence for a persistently low symptom class and a persistently elevated symptom class, which supports the validity of these two groups.

Our findings indicate that late adolescence was accompanied by a decrease in depressive symptoms for members of all classes, and that this pattern of decreasing symptoms continued through emerging adulthood for two-thirds of the sample. For the other third of the sample (i.e., the high stable class), the decrease in symptoms halted during the transition to emerging adulthood and symptoms remained stable through age 30. Uniform declines in depressive symptoms during late adolescence and subsequent differentiation of depressive symptom trajectories during the transition to emerging adulthood have been noted others (i.e., Aseltine and Gore, 1993; Schulenberg and Zarrett, 2006). During the shift into emerging adulthood, role-transitions and changes in social contexts provide some individuals an opportunity to achieve greater autonomy and new interpersonal relationships (Arnett, 2000; Schulenberg and Zarrett, 2006), which may foster emotional well-being. For others, this transition period heralds novel stressors that strengthen existing maladaptive coping repertoires and promote distress (Schulenberg and Zarrett, 2006).

Consistent with previous findings (Costello et al., 2008; Wickrama et al., 2009), women and those with personal and parental histories of MDD and substance use disorders were overrepresented in the moderate and high trajectory classes. These findings reflect the

gender imbalance in rates of depression (Nolen-Hoeksema et al., 1999) and the deleterious effects of personal (Essau, 2007; Lewinsohn et al., 2000) and familial histories of MDD and substance abuse (Beardslee et al., 1998; Su et al., 1997). Incremental to psychiatric histories, the risk conferred by interpersonal dependency, loneliness, and coping deficits for membership in the moderate and high classes is in line with interpersonal models of depression persistence (Coyne, 1976; Lewinsohn and Atwood, 1969; Libet and Lewinsohn, 1973; Pettit and Joiner, 2006).

Robust differences also emerged across the three trajectory classes in adulthood outcomes. Members of the low decreasing class uniformly displayed better psychosocial and psychiatric outcomes than those in either of the two elevated symptom classes, with members of the high stable class evidencing the worst level of functioning in adulthood. These significant differences are consistent with past findings that a more chronic course of depression predicts poorer distal outcomes (Jonsson et al., 2011; Pettit et al., 2009), and also support the predictive validity of the three classes.

The finding of differing adulthood outcomes between the moderate decreasing and high stable classes is notable, as few variables measured in adolescence distinguished these classes. In particular, academic impairment, dysfunctional attitudes, self-esteem, family support, and MDD and substance use histories in adolescence did not differentiate these classes, but the same or similar constructs assessed at age 30 did significantly differ across classes. This pattern of results suggests that persistently elevated depressive symptoms through adolescence and early adulthood may erode personal and social resources.

This study has a number of strengths, including the use of a large, school-based sample with repeated assessments over approximately 15 years. This study extends past work by assessing a range of depressive symptoms rather than sad mood, tracking participants through age 30, including women and men, assessing personal and parental psychiatric disorders using semi-structured interviews, and collecting detailed information on age 30 outcomes. In spite of these strengths, our findings should be interpreted in the context of several limitations. First, the analytic approach (GMM) is by nature exploratory and is affected by sample characteristics and variable distributions (Bauer and Curran, 2004; Tofighi and Enders, 2008). Second, we did not consider effects of psychiatric comorbidity or interaction effects of predictors in adolescence on latent trajectory classes. Future studies exploring such effects would provide a valuable extension to our work that would allow for more nuanced tests of interpersonal and cognitive models of depression. Finally, methodological limitations in the form of cross-sectional measurement and floor effects for lifetime anxiety, disruptive behavior, and parental history of anxiety disorders may have obscured the relation of these variables with the latent classes.

In summary, support was found for the existence of three depressive symptom trajectory classes from mid-adolescence through age 30. Approximately one-fourth of probands displayed persistently low depressive symptoms that decreased through early adulthood, over 40% displayed moderately elevated symptoms in adolescence that decreased through early adulthood, and about one-third displayed elevated symptoms throughout the study period. Numerous psychosocial risk factors in adolescence and personal and parental histories of psychiatric disorder distinguished probands who experienced persistently low depressive symptoms from those who experienced moderate or high symptoms. Female gender and poor interpersonal functioning in adolescence distinguished those who displayed a persistently elevated course of symptoms from those who displayed moderate symptoms in adolescence followed by a reduction in symptoms during early adulthood. Among adolescents who display elevated depressive symptoms, prevention and intervention strategies may specifically target young women and those who experience poor

interpersonal functioning in an effort to alter the long-term course of depressive symptoms. Programs that address loneliness and a sense of interpersonal dependency in adolescence may hold promise for preventing a chronic course of depressive symptoms and corresponding psychosocial impairment through early adulthood.

Acknowledgments

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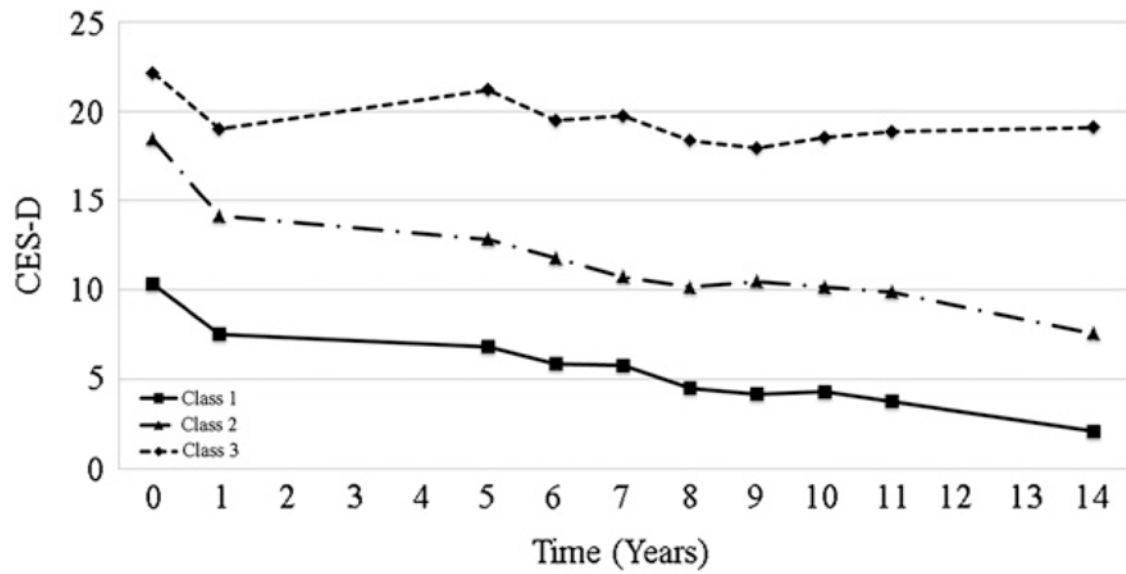
Fig. 1.
Growth Trajectories of CES-D Scores for the 3 class unconditional GMM. Class 1 = low decreasing; Class 2 = moderate decreasing; Class 3 = high stable.

Table 1

Adolescent risk factors and early adulthood outcomes.

Status Attributes	Personal and cognitive Resources or stressors	Social resources or stressors	Psychiatric and family history
Adolescent risks			
Age	Academic impairment	Family support	Lifetime ANX
Gender	Coping skills	Friend support	Lifetime DBD
	Dysfunctional attitudes	Interpersonal dependency	Lifetime MDD
	Health impairment	Loneliness	Lifetime SUD
	Self-esteem		Parental lifetime ANX
			Parental lifetime
			MDD
			Parental lifetime SUD
Adult outcomes			
Education level	Coping skills	Daily hassles	No. of lifetime ANX episodes
Income	Dysfunctional attitudes	Major life events	No. of lifetime SUD episodes
Marital status	Self-esteem	SAS family	No. of lifetime MDD episodes
		SAS social/leisure	
		SAS work	

Note: ANX = anxiety disorder; DBD = disruptive behavior disorder; MDD = major depressive disorder; SUD = substance use disorder; SAS = social adjustment scale.

Table 2

Criteria used to decide on optimal solution for number of latent classes.

Number of classes	BIC	Adj. BIC	BLRT	LMR	Entropy
1	46378.41	46318.08	–	–	–
2	46143.38	46070.34	261.35 ***	251.78 ***	.69
3	45957.02	45852.23	87.62 ***	84.41 ***	.70
4[a]	45952.44	45850.83	73.25 ***	41.68*	.73

Note: Adj. BIC = Sample size adjusted Bayesian Information Criteria. BLRT = Boot-strap likelihood ratio test. LMR = Lo-Mendell-Rubin likelihood ratio test.

**
  $p < .01$.

[a]Negative growth factor variance and covariance were constrained to 0 in Classes 2–3.

***
  $p < .001$.

Table 3

Unconditional general mixture model growth parameter estimates.

Factor means	Class 1			Class 2			Class 3			M. Wald
	Est	SE	Std	Est	SE	Std	Est.	SE	Std	
INT	5.09 ***	.32	—	10.77 ***	.43	4.16	18.31 ***	.64	2.31	429.32 ***a,b,c
SLO	−.49 ***	.04	—	−.59 ***	.07	−1.03	−.13	.09	−.14	14.85 ***b,c
QUA	.01	.01	—	.02	.01	.24	.02	.01	.14	—
INT	—	—	—	6.70 **	2.25	—	62.89 ***	7.03	—	—
SLO	—	—	—	.34 ***	.08	—	.75 ***	.14	—	—
QUA	—	—	—	.01 ***	.00	—	.03 ***	.01	—	—
Factor covariance										
INT ↔ SLO	—	—	—	.38	.27	.27	−1.53 **	.65	−.22	—
INT ↔ QUA	—	—	—	−.12 *	.05	−.63	−.98 ***	.15	−.69	—
SLO ↔ QUA	—	—	—	−.03 **	.02	−.65	.07 ***	.01	.44	—

Note: INT = intercept, SLO = slope, QUA = quadratic, Est = estimate, SE = standard error, Std = standardized estimate. Due to the centering approach, intercept values represent scores at wave 5 (year 7).

Class 1 = low decreasing; Class 2 = moderate decreasing; Class 3 = high stable. M. Wald = Multivariate Wald χ^2 (df = 2).

[d]Class 1 variance constrained to 0 for identification purposes.

[a]C1 vs. C2, p < .0001.

[b]C1 vs. C3, p .0002.

[c]C2 vs. C3, p .004.

***
p < .001.

**
p < .01.

*
p < .05

Table 4

Predictors of latent class membership.

Predictor	Odds ratio (95% confidence interval)		
	1 vs. 2[a]	1 vs. 3[a]	2 vs. 3[b]
Female gender	1.02 (.57–1.82)	1.92[*] (1.02–3.62)	1.89[**] (1.19–3.00)
Personal and cognitive			
Coping	.95[**] (.91–.99)	.94[**] (.89–.99)	.99 (.96–1.03)
Social			
Interpersonal dependency	1.11[**] (1.05–1.18)	1.16[**] (1.08–1.23)	1.04[†] (1.00–1.08)
Loneliness	1.12[**] (1.02–1.22)	1.21[**] (1.11–1.33)	1.09[*] (1.01–1.17)
Psychopathology			
Major depressive disorder	3.94[**] (1.37–11.32)	3.97[**] (1.33–11.85)	1.01 (.60–1.68)
Substance abuse disorder	6.02[*] (1.12–32.35)	8.51[**] (1.61–45.02)	1.41 (.74–2.71)
Parental psychopathology			
Major depressive disorder	1.67[*] (1.06–2.63)	1.99[**] (1.21–3.26)	1.19 (.82–1.72)
Substance buse disorder	1.40 (.92–2.14)	1.76[*] (1.12–2.76)	1.26 (.86–1.87)

Note: Class 1 = low decreasing; Class 2 = moderate decreasing; Class 3 = high stable.

[†] $p = .06$.

[a] Class 1 is the reference class.

[b] Class 2 is the reference class.

[**] $p < .01$.

[*] $p < .05$.

Table 5

Mean scores on or prevalence of distal outcomes as a function of latent class membership.

Outcome	Class 1	Class 2	Class 3	M. Wald
Status variables				
Education				
Grade 7 to 12 (no diploma)	0%	3%	2%	166.93 [***a,b]
High school/GED	1%	12%	18%	11.45 [*c]
Trade school	0%	4%	4%	16.93 [***c]
Part college	23%	30%	35%	31.41 [*** a,b,c]
2 year college	3%	9%	7%	37.66 [*, ** a,b,c]
4 year college	50%	26%	27%	12.65 [** a,b,c]
Part graduate school	1%	4%	3%	17.33 [*** a,b,c]
Completed graduate school	22%	12%	5%	—
Income[‡]				
Lower class ($0–$14,999)	2%	9%	20%	16.86 [***c]
Working class ($15,000–$29,999)	5%	18%	31%	45.78 [*** a,b,c]
Middle class or higher ($30,000 or more)	93%	74%	49%	—
Marital status				
Never married	18%	36%	39%	4.93
Married	73%	56%	44%	17.64 [***b,c]
Separated/divorced	3%	8%	17%	—
Personal and cognitive				
Coping	54.06 [***]	50.54 [***]	45.20 [***]	84.60 [*** a,b,c]
Dysfunctional attitudes	50.67 [***]	47.91 [***]	43.06 [***]	55.29 [*** a,b,c]
Self-esteem	38.12 [***]	34.77 [***]	28.13 [***]	172.30 [*** a,b,c]
Social				
Daily hassles	35.48 [***]	41.18 [***]	50.45 [***]	86.23 [*** a,b,c]
No. of major events	1.89 [***]	2.83 [***]	4.19 [***]	59.12 [*** a,b,c]
SAS family	1.28 [***]	1.44 [***]	1.77 [***]	102.47 [*** a,b,c]
SAS work	1.50 [***]	1.73 [***]	2.15 [***]	106.75 [*** a,b,c]
SAS social/leisure	1.65 [***]	1.82 [***]	2.19 [***]	65.55 [*** a,b,c]
Psychopathology				
No. of ANX episodes	.02 [***]	.13 [***]	.53 [***]	53.37 [*** a,b,c]
No. of MDD episodes	.19 [***]	.68 [**]	1.53 [***]	62.99 [*** a,b,c]
No. of SUD episodes	.45 [***]	.79 [*]	1.27 [*]	24.24 [*** a,b,c]

Note. SAS = social adjustment scale, ANX = anxiety disorder, MDD = major depressive disorder, SUD = substance use disorder; Class 1 = low decreasing; Class 2 = moderate decreasing; Class 3 = high stable. M. Wald = multivariate wald χ^2 (df = 2) and represents differences in the likelihood of falling at a higher category of education, income, or marital status.

[†]Income classes based on Thompson and Hickey (2005). Significance level of independent contrasts presented after Benjamin-Hochberg correction ($\alpha = .05$).

[a]C1 vs. C2, p .04.

[b]C1 vs. C3, p .04.

[c]C2 vs. C3, p .03.

[***]$p < .001$.

[**]$p < .01$.

[*]$p < .05$.