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LONGITUDINAL PATTERNS OF DEPRESSION SYMPTOMS AMONG EMERGING
ADULTS

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of
Philosophy at Virginia Commonwealth University

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Abstract

LONGITUDINAL PATTERNS OF DEPRESSION SYMPTOMS AMONG EMERGING ADULTS

By Sarah W. Clark, M.S.

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University

Virginia Commonwealth University, 2019

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Research has suggested that depression symptoms generally decrease after late adolescence; however, there is increasing attention paid to depression symptoms among college students given the stressors unique to this time period and negative outcomes associated with depression. This study examined latent trajectories of depression symptom severity among college students. Participants were 9,889 college students who participated in the Spitz for Science project (Dick et al., 2011). Growth Mixture Modeling was used to identify the presence of four subgroups of individuals with similar patterns of initial level and change in depression severity over four years of college, including *Low/Minimal* (55.9%), *Decreasing* (2.8%), *Increasing* (11.6%), and *Chronically Elevated* (29.7%) groups. Risk factors of belonging to a depressed mood trajectory include female gender; lesbian, gay, or bisexual orientation; and experiencing a greater number of stressful life events. Higher social support

and self-reported resilience were associated with decreased likelihood of belonging to any of the depressed mood trajectories. Overall, it appears that most college students in this sample experience only mild depression symptoms; however, it is important to recognize and intervene early with individuals who report elevated depression symptoms as some are at risk for persistent and increasing depression across college.

Longitudinal Patterns of Depression Symptoms among Emerging Adults

“Emerging adulthood” is a term coined by Arnett to describe individuals aged 18-25 in industrialized countries, in recognition of the dynamic influences on development during this age (Arnett, 2000, 2007). This period represents a time when individuals take on new responsibilities and the freedoms of adulthood but are often not yet fully independent from their families of origin. As they navigate new challenges, such as completing their education, starting a career, and entering committed romantic relationships, they may experience additional stress, which in turn may contribute to depression (Dyson & Renk, 2006; Vrshek-Schallhorn et al., 2015). Thus, this developmental period has received additional attention as a vulnerable period for depression symptoms (Costello, Egger, & Angold, 2005; Kessler et al., 2003; Rohde, Lewinsohn, Klein, Seeley, & Gau, 2013). Although most individuals adapt quite well to these new challenges, depression symptoms may occur and contribute to emotional distress and reduced social and occupational functioning (Galambos, Barker, & Krahn, 2006; Gotlib, Lewinsohn, & Seeley, 1998; Vujeva & Fruman, 2011).

Depression symptoms in emerging adulthood are important to consider for several reasons. Onset of depression symptoms prior to age 21 is associated with greater likelihood of experiencing chronic symptoms, as well as greater recurrence and impairment from depression symptoms (Dekker, Ferdinand, van Lang, Bongers, van der Ende, & Verhulst, 2007; Klein, 2008; Kovacs, Feinberg, Crouse-Novak, Paulauskas, & Finkelstein, 1984). Impairment includes both reduced social functioning as well as, importantly for college students, reduced educational and occupational attainment (DeRoma, Leach, & Leverett, 2009; Hysenbegasi, Hass, & Rowland, 2005; Kessler, Foster, Saunders, & Stang, 1995). Depression is also associated with a number of poorer health outcomes including greater

engagement in risky lifestyle behaviors such as smoking, alcohol use, risky sexual behaviors, as well as poorer health overall (Dierker et al., 2015; Naicker, Galambos, Zeng, Senthilselvan, & Colman, 2013; Sandberg-Thoma & Kamp Dush, 2014)

Studies of depression symptoms across developmental periods have tended to focus on adolescence (ages 10-19), as this is often the time when depression symptoms first appear. The literature on depression symptoms across adolescence has established that, generally, depression symptoms follow an inverted U-shaped curve: increasing in the early teens, peaking around ages 15-17 and decreasing thereafter (Ge, Lorenz, Conger, Elder, & Simons, 1994; Ge, Natsuaki, & Conger, 2006; Hankin et al., 1998). This pattern occurs when examining overall trends within this population, as well as when specific subgroups are examined. For instance, females and individuals from diverse racial/ethnic backgrounds demonstrate the same overall pattern of increasing then decreasing symptoms, but consistently report more severe symptoms compared to males and European-American counterparts, respectively (Meadows et al., 2006; Adkins et al., 2009; Chen, Haas, Gillmore, & Kopak, 2011). It should be noted, however, that the similar overall pattern may be due to limitations of the methods which cannot identify subgroups within the overall sample. Research has less often extended through the full emerging adult period, although some extend into the late teens. Studies that have continued to track depression symptoms into the early years of adulthood do tend to find decreasing and then leveling off of depression symptoms (Ge et al., 2006; Pettit, Lewinsohn, Seeley, Roberts, & Yaroslavsky, 2010; Yaroslavsky et al., 2014).

More recently, research has turned to examine potential clusters of individuals with similar trajectories of depression symptoms over time, using growth mixture modeling and

other person-centered analytic techniques (e.g. Costello et al, 2008; Ferro et al., 2015a, Yaroslavsky et al., 2014). Using these methods, researchers have identified multiple, heterogeneous trajectories of symptoms in both adolescence and emerging adulthood (Chaiton et al., 2013; Costello et al., 2008; Ferro et al., 2015b; Frye & Liem, 2011; Salmela-Aro, Aunola, & Nurmi, 2008; Stoolmiller et al., 2005; Wickrama & Wickrama, 2010; Wickrama, Wickrama, & Lott, 2009; and Yaroslavsky et al., 2014). Through these methods, groups that differ qualitatively in terms of initial level and change in severity over time are able to be identified. Notably, the largest group typically found is one reporting low or minimal depression symptoms throughout emerging adulthood (Costello et al., 2008; Ferro et al., 2015b; Frye & Liem, 2011; Yaroslavsky et al., 2014). Smaller proportions of the population comprise depressed mood groups that increase, decrease, or remain consistently elevated over the developmental period of study (Costello et al., 2008; Ferro et al., 2015b; Frye & Liem, 2011; Yaroslavsky et al., 2014). This suggests that the average trend may not adequately capture the heterogeneity within the population, and therefore lead to misleading conclusions, such as that moderate depression symptoms are normative at some periods in development. Instead, the increase of depression symptoms in late adolescence may reflect a subgroup with increasing or chronically elevated depression symptoms.

Much work has already been done on identifying factors that increase the risk of belonging to a depressed mood trajectory; that is, a pattern with elevated depression symptoms at some point during the relevant developmental period. These have tended to focus on already-established risk factors for depression, such as demographic characteristics and exposure to stressful events. Consistent with the overall depression literature, female sex and being a member of a racial/ethnic group have consistently been found to be associated

with increased likelihood of membership in depressed mood trajectories (Adkins et al., 2009; Ferro et al., 2015b; Frye & Liem, 2011; Galambos et al., 2006; Meadows et al., 2006). Further, exposure to stressful life events and daily hassles is also associated with belonging to a depressed mood group (Adkins et al., 2009; Pettit et al, 2010; Wickrama et al. 2008). Some work has also been done to examine potential protective factors that distinguish between depressed mood groups, such as social support, self-esteem, and family structure (Costello et al., 2008; Pettit et al, 2010; Yaroslavsky et al., 2014); however, this is limited to only a few studies and results thus far are mixed.

The Present Study

The present study builds on literature suggesting the presence of multiple heterogeneous trajectories of depression severity during emerging adulthood (Adkins et al., 2009; Costello et al, 2008; Galambos et al, 2006; Pettit et al, 2010; Wickrama et al. 2008). However, gaps remain. Few studies have examined the entire emerging adult period. Although some studies have examined potential heterogeneous trajectories in depression among college students, sample sizes were small (Galambos et al., 2005; Salmela-Aro et al., 2008). The current study examined heterogeneous trajectories of depression symptoms among a large, diverse college student sample. Further, it examined these trajectories in terms of both predictors and behavioral correlates of depressed mood trajectories. Growth mixture modeling was used to examine whether multiple subgroups with similar patterns of change in depression symptom severity over time could be identified within the sample. Then, covariates were explored including risk factors, protective factors, and behavioral correlates. In sum, this study adds to the literature by clarifying how depression symptoms fluctuate across emerging adulthood and by distinguishing among multiple, heterogeneous

trajectories of depression severity. This allowed for description of common trajectories of depression symptom severity that are not readily identified when only a single trajectory is considered, including identifying factors that contribute to more severe or chronic patterns.

Literature Review

In considering depressive symptoms through the transition to adulthood, it is important to understand developmental context. “Emerging adulthood” is a term developed by Arnett (2000, 2007) to describe the distinct developmental period between adolescence and later adulthood. Specifically, it refers to the period spanning the late teens to the middle twenties (i.e. ages 18-25) in industrialized societies. This time period is characterized by a high degree of heterogeneity in both patterns of and influences on development. During this period, emerging adults experience aspects of both child- and adulthood. They acquire greater responsibility but still maintain close contact and often a level of dependence on their families. Similar to adolescents, most have not yet started families of their own, entered committed romantic relationships, completed their education, achieved financial independence, or established careers (Cohen, Kasen, Chen, Hartmark, & Gordon, 2003; DeMarco & Berzin, 2008). On the other hand, they are legally autonomous, may live apart from their families of origin, some can vote and drink alcohol legally, and can accrue financial responsibilities like the adults they are (Cohen et al., 2003).

Depression Symptoms among Emerging Adults

Given the myriad changes experienced, emerging adulthood has gained attention as a time of increased stress and vulnerability for depression. Indeed, the first onset of three-fourths of diagnosable psychological conditions occurs by age 24 (Kessler et al. 2005). More specifically, depressive symptoms often first appear in adolescence, with highest levels just

before the transition to adulthood (Hankin, et al., 1998; Costello, et al., 2008). Notably, earlier onset of depressive symptoms is associated with worse outcomes. For instance, individuals who report depressive symptoms prior to age 21 are more likely to experience major depressive episodes and these more often recur when compared to individuals who first report depressive symptoms after age 21 (Kovacs et al., 1984; Dekker et. al, 2007; Klein, 2008). This is true whether symptoms meet clinical significance or not (Klein, 2008). Thus, effective intervention for depressive symptoms during late adolescence and the transition to adulthood may prevent many later difficulties.

Although emerging adults experience increased well-being during the transition from adolescence into early adulthood, some persistent and worsening depression symptoms during this period. Emerging adulthood is generally associated with increased risk of psychological problems (Rohde et al., 2013), with college students reporting similar incidence of mental health problems than non-college attending peers (Blanco, Okuda, Wright, Hasin, Grant, Liu, & Olfson, 2008; Ibrahim, Kelly, Adams & Glazebrook, 2013). However, college students also experience specific types of stressors. Consistent with the general population of emerging adults, college students also report increasing rates of depression and greater mental health needs both before they arrive and while at college (Blanco et al., 2008; Ibrahim et al., 2013; Gallagher, 2013). Depression symptoms during this period may in part be explained by stress from navigating new responsibilities along with shifting support networks. Depression symptoms among college students has been associated with increased stress related to new academic, social, and financial responsibilities and decreasing dependence on their family (Compas, Wagner, Slavin & Vannatta, 1986; Dyson & Renk, 2006; Clearly, Walter, & Jackson, 2011).

Further, it is important to examine how the influence of these factors might change over time and developmental contexts. As noted, depression symptoms are likely to first appear in adolescence. Similar factors may predispose individuals to depressive symptoms during adolescence and emerging adulthood, but the effect of these may vary over time. Research on adolescence has focused on early life experiences (stressful life events, early parental divorce), demographic factors (gender, race/ethnicity, socioeconomic status), and family relationships (Hankin et al., 1998; Ge et al., 1994; Ge et al., 2006, Dekker et al., 2007). These are also likely to be associated with depression symptom course in emerging adulthood. However, other factors may become relevant in this period. Notably, factors that mark the transition to adulthood and the growing independence associated with emerging adulthood may become more relevant (Arnett, 2000; Arnett, 2007). This may include peer relationships, occupational satisfaction, or financial security, among others. An individual's ability to cope with and navigate these challenges is likely to be related to depression symptoms in the short term. Furthermore, these are likely to be related to health behaviors, such as alcohol and substance use and sexual behaviors, as the individual both attempts to cope with stressors and/or sets behavioral patterns that may have lifelong consequences beyond this period.

Longitudinal Patterns of Depressive Symptoms

Longitudinal patterns of depression have been studied to understand how depressive symptoms may vary normatively across development and to identify vulnerable periods for depression. As previously noted, depressive symptoms often first arise in adolescence. Thus, studies examining longitudinal patterns have tended to focus on this period. Considering two large-scale longitudinal studies that examined depressive symptoms in adolescence,

depression symptom severity appears to follow an inverted U-shaped trajectory of increasing and then decreasing symptoms over the course of adolescence to young adulthood (Ferro, Gortler, & Boyle, 2015b; Ge, Lorenz, Conger, Elder, & Simons, 1994; Hankin et al., 1998; Natsuaki, Biehl, & Ge, 2009). Highest depressive symptoms were found in late adolescence, ages 15-17 (Adkins, Wang, & Elder, 2009). Following this, depressive symptoms appear to decrease as adolescents transition to adulthood (Ferro et al., 2015b; Natsuaki et al., 2009; Yaroslavsky, Pettit, Lewinsohn, Seeley, & Roberts, 2014).

Notably, these studies describe self-reported depressive symptoms rather than a diagnosis of depression. Although clinical (i.e. diagnosable) depression is important to consider, subclinical symptoms may hint at a later rise to clinical levels in addition to conferring more nuanced understanding of how mood symptoms fluctuate across development. Further underscoring the value of considering symptom courses over time, the onset and fluctuation of depressive symptoms over time is associated with recurrence and impairment of depressive disorders (Klein, 2008). Specifically, onset and persistence appears more important than severity in predicting outcomes and response to treatment, with individuals with earlier onset and more enduring courses faring worse (Klein, 2008).

Average trajectories of depressive symptoms in emerging adulthood. Consistent with this, previous research has strongly supported that the average score on self-report measures of depression decrease during the emerging adult period (Hankin et al., 1998; Yaroslavsky et al., 2014; Ferro et al., 2015b). This finding has been replicated in both large, nationally representative samples as well as in smaller, convenience samples. Within samples representative both of United States and Canadian populations, researchers consistently reported declines in depression severity after age 18 and through the emerging adult years

(Adkins et al., 2009; Ferro, Gortler, & Boyle, 2015a.; Ferro et al., 2015b; McPhie & Rawana, 2015; Meadows et al., 2006; Natsuaki et al., 2009; Rawana & Morgan, 2013). Smaller samples also supported a declining trend, including a community based-sample in Canada ($N=920$, Galambos et al. 2006), within a randomly-selected community-based sample in Oregon ($N=815$, Pettit, Lewinsohn, Seeley, Roberts, & Yaroslavsky, 2010; $N=816$, Pettit, Roberts, Lewinsohn, Seeley, & Yaroslavsky, 2011), within a rural Midwest, European-American-only sample ($N=485$, Wickrama, Conger, Lorenz, & Jung, 2008); and within an all-male “at risk” sample in Oregon ($N=206$, Stoolmiller, Kim, & Capaldi, 2008).

To further clarify the course of depressive symptoms across emerging adulthood, researchers have sought to identify factors associated with greater depression (1) by considering subgroups hypothesized to be at greater risk and (2) by identifying factors influencing severity within a single, average trajectory. First, subgroups hypothesized to be at greater risk will be discussed. These have tended to focus on specific demographic factors, such as sex and race/ethnicity. Then, factors influencing trajectories will be considered.

Subgroups hypothesized to be at greater risk for depressive symptoms. Perhaps most frequently, research has examined the influence of biological sex in depression severity during emerging adulthood. Males and females have been shown to differ in their risk of depression symptoms across the lifespan. Accordingly, sex differences in depression symptoms across emerging adulthood have been considered. Specifically, a robust gender disparity in depressive symptoms has been found, with females reporting greater depression severity starting first in adolescence and continuing into adulthood. Several studies drew from the National Longitudinal Study of Adolescent to Adult Health (AddHealth) dataset, a nationally representative, longitudinal survey in the United States (Meadows et al., 2006;

Adkins et al., 2009). These studies demonstrate that, although males and females both report decreasing depressive symptoms across ages 18 to 25, females report consistently higher levels compared to males. Other, smaller samples replicated this finding, providing robust support for a gap between males and females in depression symptoms during emerging adulthood (Ferro et al., 2015b; Frye & Liem, 2011; Galambos et al., 2006; Ge et al., 2006; Meadows et al., 2006; Rawana & Morgan, 2013; Yaroslavsky et al., 2014).

That said, there is some evidence that the disparity between males and females narrows with time. Despite overall higher scores on self-report measures of depression, females report steeper declines in symptoms over time when age-related changes are explored (Adkins et al., 2009). For example, within a nationally-representative Canadian sample, Rawana and Morgan (2013) examined the change in scores on a 12-item version of the Center for Epidemiological Studies Depression Scale (CES-D) across ages 12-21 (N=4,359). They found a significant gender effect at each age, with the exception of age 20, and noted a narrowing in the difference between genders. The weakening effect of sex over time appears to be due in part to males and females reporting more similar levels of depression severity as they moved through emerging adulthood, with females experiencing steeper declines in symptoms. The gap between male and female depression symptoms also narrowed over time in a school-based sample of 920 Canadian adults aged 18-25 (Galambos et al., 2006). Of note, the narrowing gender disparity identified in these studies may be temporary as there is a robust literature documenting a gender gap in depression in later adulthood (Mirowsky, 1996).

Racial/ethnic group membership (e.g., White, Latina/o, African-American) has also been explored as affecting the trajectory of depression symptoms during emerging adulthood.

Similar to the effect of female gender, it appears that minority race/ethnicity contributes to greater severity in depressive symptom severity across emerging adulthood, although a similar pattern of declining symptoms is noted. Individuals of diverse racial/ethnic backgrounds reported higher overall levels of depression symptoms despite demonstrating the same general pattern of decreasing symptoms in two studies drawing from AddHealth (Adkins et al., 2009; Chen et al., 2011). Persons from racial or ethnic backgrounds may be more at risk for depression symptoms compared to European-American counterparts, and this is more pronounced for African American and Latina/o individuals than for Asians (Adkins et al., 2009; Chen et al., 2011). That is, while persons from Asian, African-American, and Latino/a backgrounds report greater depression symptoms compared to White peers, African-American and Latino/a individuals report greater symptoms compared to Asian peers.

In addition, one study explored trajectory of depressive symptoms among emerging adults identifying as a sexual minority (i.e. gay, lesbian, bisexual, or mostly heterosexual) compared with exclusively heterosexual individuals. Marshal, Dermody, Cheong, Burton, Friedman, Aranda, and Hughes (2013) examined longitudinal trajectories of depression and suicidality from ages 13-31 among persons identifying as gay, lesbian, bisexual, or mostly heterosexual using the AddHealth sample (N=12,379). Sexual minority youth reported higher levels of depression symptoms and suicidality than exclusively heterosexual peers at all time points. Again, however, the same pattern of increasing symptoms in adolescence and declining depression in adulthood was found. In addition, lesbian and bisexual females reported the highest levels of depressive symptoms overall. This suggests that while females are generally more likely to experience symptoms of depression, sexual minority identity may further increase this risk. Notably, sexual minority identity was often not endorsed in the

initial data collection waves but was at later waves; thus, this prospective approach allowed for identification of depression symptoms before this identity was disclosed within the study.

Other subgroups that have been considered are individuals with childhood-onset chronic illness (Ferro et al., 2015a), early or late pubertal timing (Natsuaki et al., 2009), and specific genetic profiles (Adkins, Daw, McClay, & van den Oord, 2012). With the exception of genetic influences (Adkins et al., 2012), these factors discussed only alter the severity of symptoms within the same pattern of decreasing symptoms across ages of 18-25. Childhood-onset chronic illness, off-time maturation (early or late), and early dating compared to peers have been associated with increased depression (Ferro et al., 2015a; Natsuaki et al., 2009). Factors which set individuals apart from peers may contribute to more stressful environments, explaining why individuals from these subgroups are more prone to and recover more slowly from depression symptoms. Females may be particularly sensitive to these effects, reporting greater effect when these other factors are present, such as minority sexual identity (Marshall et al., 2013) or off-time maturation (Natsuaki et al., 2009). Minority status, chronic illness, and early or late puberty increase stress by differentiating individuals from peers in adolescence—a time when fitting in is of the utmost importance. The waning effect may suggest that individuals learn to cope with these differences, or differences may become less salient over time. On the other hand, genetic and sex effects suggest differences in vulnerability to depression. The studies reviewed suggest most individuals report declines in depression, with some subgroups reporting higher levels compared to peers.

Factors influencing severity of depression symptoms in emerging adulthood.

Research to date has focused on factors influencing depressive symptom severity within a single, common trajectory. Most often, this has focused on stressors, both acute and chronic.

Discrete, acute stressful life events contribute to greater depressive symptoms over time (Meadows et al., 2006; Adkins et al., 2009). In addition, indicators of more persistent stressors, such as lower socioeconomic status in childhood, are also associated with greater severity of depressive symptoms in emerging adulthood (Adkins et al., 2009; Pettit et al., 2010; Wickrama et al. 2008). Females and racial and ethnic minorities appear to be more sensitive to the effects of stressors, reporting greater increases in depression as a result (Ge et al., 2006; Pettit et al., 2010).

Other factors that have been shown to influence severity of depressive symptoms in emerging adulthood have focused on social relationships. Perceived family support was associated with lower levels of depression in emerging adulthood, although this effect weakened with time, likely reflecting age-appropriate changes in support networks (Meadows et al., 2006). Perceived social support generally increases during emerging adulthood and is associated with concurrent decreases in reported depression symptoms (Pettit et al., 2011); however, only perceived family support was significantly and negatively associated with depression symptoms in early adulthood. The effect of family support, but not peer support, contrasts with the increasingly important role that peers begin to play as emerging adults gain independence and autonomy, and may reflect the generally high level of peer support across the ages studied (21-30). However, more research is needed, as Costello and colleagues demonstrated connection to family, peers, and school acts as a protective factor against development of depression during adolescence and young adulthood (Costello et al., 2008).

Notably, the previous sections review research focused on an average trajectory of depressive symptom severity through emerging adulthood. Although important to understand

a “typical” course of depression severity within a population, this may obscure individual differences. An average or prototypical trajectory examines how individuals differ quantitatively in depression severity but assumes all follow the same general pattern (Bauer & Reyes, 2010). That is, it suggests a general, curvilinear trajectory of rising symptoms in adolescence and decreasing symptoms from late adolescence through emerging adulthood; however, individuals may report higher or lower depression levels within this pattern and it is not possible to identify other patterns that may be present for individuals or groups of individuals within the population.

Heterogeneous trajectories of depressive symptoms in emerging adulthood.

Among studies examining average trajectories, some noted substantial variation among individuals in the severity of symptoms through emerging adulthood (e.g. Rawana & Morgan, 2013). Thus, more recent efforts have focused on identifying multiple, distinct trajectories based on groups of individuals with similar patterns of depression symptoms over time. Statistical methods can disentangle these heterogeneous subgroups from the average (Bauer & Curran, 2003), and explore both qualitative and quantitative differences in trajectories between these subgroups (Bauer & Reyes, 2010). Structural equation approaches can be used to identify latent groups of individuals with similar patterns of depression symptoms over time, and factors which distinguish these groups. Focusing on the course of symptom severity over time can uncover latent groups of individuals who are similar based on variation of depression severity rather than based on common risk factors. This may be particularly important as only a small proportion of emerging adults report significant depression symptoms, but their severe symptoms may influence the overall average.

To date, eight published studies have examined heterogeneous trajectories of depression during the emerging adult period (Costello, Swendsen, Rose, & Dierker., 2008; Ferro et al., 2015b; Frye & Liem, 2011; Salmela-Aro, Aunola, & Nurmi, 2008; Stoolmiller et al., 2005; Wickrama & Wickrama, 2010; Wickrama, Wickrama, & Lott, 2009; and Yaroslavsky et al., 2014). Sample characteristics are important to consider in discussing the number and pattern of latent groups as spurious trajectories may be identified in latent growth curve modeling if the sample is too small or biased in some way, (Bauer & Curran, 2003, 2004). Further, a small sample may not be able to detect a subgroup of individuals reporting severe depression, shown in epidemiological studies to have a prevalence of approximately 6% among adults (Kessler, et al., 2003). In reviewing the results from these studies, evidence regarding the form and number of multiple trajectories will be discussed, emphasizing studies that are more methodologically rigorous. Then, factors which distinguish between trajectories will be discussed. See Table 1 for a summary of these studies.

Table 1.

Studies Examining Heterogeneous Trajectories during Emerging Adulthood

Study	Sample	Methodological considerations	Notable findings
Costello et al., 2008	N=11,559 participants from AddHealth dataset across 3 waves	-Sum of 3 CES-D items reflecting affective components of depression -Created age categories spanning 2-4 years as the longitudinal unit of analysis	-Identified 4 trajectories of depression symptoms across adolescence and into emerging adulthood: 28.7% “No Depressed Mood,” 59.4% “Stable Low Depressed Mood,” 9.5% “Early Declining,” and 2.4% Late Escalating
Ferro et al., 2015b	N=2,825 Canadian individuals across ages 10-25	-12 items from the CES-D -Assessments every 2 years -Controlled for a large number of individual, parental, and family variables	-Identified 3 trajectories: 55% “Minimal,” 29% “Subclinical,” and 6% “Clinical” -Groups were stable relative to each other (consistently higher or lower without crossing) -Peak depressive symptoms for each group during late adolescence with declines thereafter
Frye & Liem, 2011	N=1,143 Boston-based cohort of high school graduates over ages 18-22	-Only 3 assessments, limiting analysis to linear effects over time -Small groups when divided into multiple trajectories	-Identified 4 trajectories: 75% “Low Stable,” 17% “Decreasing,” 7% “Increasing,” and 1% “High Stable”
Salmela-Aro et al., 2008	N=297 Finnish university students	-Small sample which may not be adequately powered to identify reliable findings	-Identified 3 trajectory groups: “Low,” “Moderate,” and “High-Increasing”
Stoolmiller et al., 2005	N=206 male youths from a higher-crime city in Oregon	-Small sample, convenience sampling -Described all-male sample as “at risk”	-Identified 4 trajectory groups: “Very Low,” “Moderate-Decreasing,” “High-Decreasing,” and High Persistent”
Wickrama & Wickrama, 2010	N=11,500 participants from AddHealth dataset	-Sum of 8 items from the CES-D including affective, cognitive, and physical symptoms -Used age as the longitudinal unit of analysis	-Identified 4 trajectories: 63% “Low,” 8% “Decreasing,” 3% “Escalating,” and 13% “Moderate-High”
Wickrama et al., 2009	N=14,058 participants from AddHealth dataset	-Created groups based on depression score (high or low) and change over time (more or less than one standard deviation)	-Identified 4 theoretically-derived groups constructed a priori based on depression score and change over time: “Stable Low,” “Stable High,” “Increasing,” and “Decreasing”
Yaroslavsky et al., 2014	N=719 individuals recruited between ages 14-18 and followed over 15 years	-20 items from the CES-D -Used time as the unit of analysis, which may obscure important age related differences	-Identified 3 trajectories: 24% “Low Decreasing,” 44% “Moderate Decreasing,” 32% “High Stable” -Groups stable relative to each other (remaining consistently higher or lower)

Two studies drew from the AddHealth dataset and used structural equation modeling approaches. Because a larger, nationally-representative sample will be well-powered to detect heterogeneous patterns if they exist, stronger conclusions may be drawn from these studies. Using a sample of 11,559 individuals across three waves of data collection, Costello and colleagues (2008) identified four trajectories of depression symptoms across adolescence and into emerging adulthood: no depressed mood (28.7%), stable low depressed mood (59.4%), early declining (9.5%), and late escalating (2.4%) groups. Although the early declining group reported higher levels of symptoms during adolescence, they were virtually indistinguishable in terms of depression severity by the end of emerging adulthood, age 25. In contrast, though the late escalating group reported similar levels of depression in early adolescence, they reported increasing symptoms across adolescence, and these continued to rise after age 18.

Wickrama and Wickrama (2010) used a similarly-sized sample of 11,500 individuals from AddHealth and the same waves of data; however, results differed from those identified by Costello et al. (2008), likely due to methodological differences. Although they also identified four classes of trajectories, the pattern and relative proportion of the sample each comprised differed. They identified a low (63%), decreasing (8%), escalating (3%), and moderate-high (13%) group using Latent Class Analysis. The decreasing group reported initially high levels of symptoms during early adolescence, with decreasing symptoms, including a sharp decline after age 18. The escalating group, however, reported similarly low levels of depression symptoms as the low group in adolescence, but increasing symptoms over time.

Differences in depression items used and analytic method likely contributed to these inconsistent findings between these two studies. Costello and colleagues (2008) used the sum of three items from the CES-D assessing affective components of depression as their outcome measure whereas Wickrama & Wickrama (2010) used the sum of eight items from the CES-D, reflecting affective, cognitive, and physical symptoms of depression. Costello et al. (2008) used chronological age to measure time, but created age categories that spanned two (for ages 13-21) or four (ages 22-25) years to improve data coverage whereas Wickrama & Wickrama (2010) restructured their data to use age as the longitudinal unit of analysis. Additionally as Wickrama and Wickrama used a more comprehensive measure of depression symptoms and restructured data according to age rather than constructing broad age categories, these methods may better reflect how depression severity, including affective and physical components of depression, fluctuate with age.

Considering other nationally-representative samples, Ferro et al. (2015b) included data from 2,825 Canadian individuals across the ages of 10 to 25. They identified only three classes of trajectories: minimal (55%), subclinical (39%), and clinical (6%). These groups were stable relative to each other (consistently higher or lower), but with a peak period of risk during late adolescence with declines thereafter. More items from the CES-D were included (12), and assessments were conducted more frequently than in the AddHealth (every 2 years) study.

Their identification of fewer trajectory groups may be due to the smaller sample size and lack of oversampling minority and low income individuals, who typically report more severe symptoms. In addition, they controlled for a large number of individual, parental, and family variables. Adjusting for these control variables had a large effect on the depressed

groups and smaller effect on the minimal group reducing variability among the latent groups. It is possible that methodological and analytic differences precluded identification of other depressed groups, such as those with increasing or decreasing symptoms over time.

From these large, nationally-representative samples, a few conclusions may be drawn. It appears the majority of individuals report minimal or low symptoms of depression through emerging adulthood. As the majority of studies describe the shape of latent classes relative to each other, it is difficult to compare classes across studies as classes were described as high or low as compared to each other within the study. Future studies should attempt to use measures that will facilitate comparison across study results. This could be accomplished by using standardized measures or selecting measures with clinical cut scores. Costello et al (2008) report a group with stable low symptoms, which when combined with the minimal group, represents the majority of individuals (88%). Although the naming of this group might indicate the presence of a dysthymic group, the average score on the 3-item CES-D across time is one, indicating the presence of these symptoms “some or little of the time.” With a more comprehensive measure of depression symptoms, it appears there may be a group with more significant and persistent elevations in depression as both Wickrama & Wickrama (2010) and Ferro et al. (2015b) identified a group with chronically elevated symptoms.

The literature also includes results from smaller school and community-based samples. First, Frye & Liem (2011) discussed findings from 1,143 Boston-based a cohort of high school graduates recruited during their Senior year and followed from age 18 to 22. As with the AddHealth studies, four trajectories were identified: low stable (75%), decreasing (17%), increasing (7%) and high stable (1%). Like the studies by Costello and colleagues

(2008) and Wickrama and Wickrama (2010), they also identified two groups with varying severity over time. As with the previously described studies, a consistently low group comprising the majority of emerging adults and a consistently high group were identified. These results, especially the relative percentages, are limited however. Despite recruiting over 1,000 participants, analyses resulted in fairly small groups when divided into multiple trajectories. Notably, only 13 participants were in the high stable group.

Yaroslavsky et al. (2014) drew from a randomly selected sample of high school students in Western Oregon, $N=719$, following a cohort of individuals aged 14-18 over 15 years. Growth mixture modeling identified three trajectory groups. As with previous research, most individuals reported decreasing symptoms from adolescence through adulthood and fell into two declining trajectories: “low decreasing” (24%) and “moderate decreasing” (44%). The remaining 32% of participants made up a “high stable” group. Depression levels appeared to remain consistent over time in the “high stable” group but continued to decrease for the other two groups. Trajectories were also rank-ordered, remaining higher or lower than each other over time. This study used a more comprehensive measure of depression symptoms, 20 items from the CES-D, rather than being limited to depressed mood (as in Costello et al., 2008). However, it was limited by using time of assessment as the unit of analysis. Although a group of high school-aged students were followed over time, this may obscure age-related developments, including the possibility of classes where depression symptoms change in severity with age.

Two additional studies provided information from much smaller samples. Salmela-Aro and colleagues (2008) followed 297 Finnish university students and identified three trajectory groups: low, moderate, and high-increasing depression groups. In an early effort,

Stoolmiller and colleagues (2005) recruited a sample of 206 male youths from schools in a higher-crime city in Oregon. They identified four trajectory groups: very low, moderate-decreasing, high-decreasing, and high persistent. Within these small samples that were not randomly selected, findings are less likely to be reliable. However, findings from Stoolmiller et al. (2005) may suggest that the proportion of individuals in depressed classes may be higher in at-risk samples than in the general population, as only a small proportion of individuals fell into their “very low” class. Even so, this should be considered preliminary information given the small sample size and limited sample population, as results may not generalize widely.

Taken together, these studies suggest several things about the presence of heterogeneous trajectories of depression symptoms across emerging adulthood. First, it appears that there is evidence to suggest multiple common trajectories that can be disentangled from the average. The number of distinct trajectories has varied between three and four. Rank-ordered classes that remained persistently higher or lower than other trajectories were found only in studies identifying three trajectories. Smaller samples and those that control for more variables may not be able to detect patterns of increasing or decreasing symptoms. Second, two types of trajectories have been regularly found: a consistently low or non-depressed trajectory and a consistently elevated depressed group. The most commonly found, and typically comprising the largest proportion of the sample, is a group reporting consistently low or minimal depression severity. Regarding the second, it appears that a small minority of individuals with persistently elevated symptoms also likely exists. This group may reflect individuals with Persistent Depressive Disorder (American

Psychiatric Association, 2013), although diagnostic criteria were not directly assessed in the studies reviewed.

An additional study used the AddHealth sample, but its method of analyzing heterogeneous trajectories differs significantly from the other studies described. Wickrama, Wickrama, and Lott (2009) created four theoretically-derived trajectory groups rather than using a statistical approach. Based on previous research supporting a four-trajectory solution, they constructed four trajectories a priori based on depression scores' severity (high or low) and change over time (more or less than one standard deviation; Wickrama, Wickrama, & Lott, 2009). Because these classes were constructed rather than derived through statistical analysis, the validity of these groups depends on the soundness of the theory underlying the creation of four distinct trajectory groups, and may not necessarily correspond to naturally-occurring trajectories. This appears premature at this time as the number and form of depression trajectories through emerging adulthood is still developing and inconsistent, as noted in the previous studies reviewed.

Factors associated with depressed mood trajectories. By identifying heterogeneous trajectories, researchers have aimed to identify factors that distinguish among longitudinal patterns as well as outcomes associated with these trajectories. First, factors predicting membership in depressed mood trajectories will be reviewed. Generally, this has focused on risk factors. Then, outcomes associated with trajectories will be discussed.

Likelihood of belonging to a depressed trajectory subgroup is associated with a number of the factors already identified to contribute to more severe depression symptoms in average trajectories. Females were over-represented among depressed mood groups in nationally-representative U.S. (Costello et al., 2008) and Canadian (Ferro et al., 2015b)

samples as well as smaller school and community-based samples (Frye & Liem, 2011; Yaroslavsky et al., 2014). Minority race or ethnicity also predicted greater likelihood of being in a trajectory of increased depression symptoms (Costello et al., 2008; Frye & Liem, 2011; Wickrama et al., 2009).

Similarly, a more negative developmental history was associated with depressed mood trajectories. Considering first nationally-representative samples, lower socioeconomic status (SES) during childhood (Costello et al., 2008; Ferro et al., 2015b) and presence of chronic health conditions (Ferro et al., 2015b) were associated with greater likelihood of a being included in a depressed trajectory. Smaller studies considered a broader range of predictors, but all generally indicated a less favorable outcome for individuals with more adverse family of origin conditions. Parental mental health problems predicted depressed group membership in a community-based sample of adolescents in Oregon (Yaroslavsky et al., 2014) and an at-risk sample of males (Stoolmiller et al., 2008). Previous trauma predicted depressed mood group membership among a Boston-based community sample (Frye & Liem, 2011). Adversity in family of origin appeared to initiate depressive symptoms by contributing to earlier transition to adulthood (Wickrama et al. 2008) within a rural, European-American-only sample ($N=485$). When individuals come from chaotic and adverse family or origin, they may be at more at risk due to greater stress in their lives as well as taking on the responsibility of adulthood before they are ready and with less support.

Consistent with this, engagement in risky behaviors differed among depressed mood trajectories. Costello et al. (2008) noted increased alcohol and other drug use and delinquent behavior was associated with depressed mood trajectories compared to a no depression trajectory. Persons in depressed groups showed significantly higher rates of most risky

lifestyle behaviors at age 23, including having multiple sexual partners, being arrested, and smoking tobacco (Wickrama & Wickrama, 2010). Both Costello and colleagues (2008) and Wickrama & Wickrama (2010) noted highest rates of risky lifestyle behaviors among individuals belonging to a trajectory with increasing depression symptoms during the transition to adulthood. These risky lifestyle behaviors may reflect unhealthy coping strategies for managing negative mood states, like depression, or may be associated with increased depression through other mechanisms, such as unhealthy peer influences.

On the other hand, there has been some work in identifying protective factors, although this is limited primarily to one study. Costello and colleagues (2008) identified several protective factors were identified that predicted membership in the non-depressed group using the AddHealth sample. These included two-parent family structure, and perceived family, peer, and school support. However, this study relied on brief measures of these constructs. Social connection was measured by two questions assessing perceptions of family and friends as caring and five items measuring connection to school. Additionally, high self-esteem (measured by a six items) was associated with membership in non-depressed group. The effect of self-esteem was not supported by Yaroslavsky et al (2014) within a smaller, geographically limited sample. Generally, specific work on identifying protective factors that differentiate between heterogeneous trajectories appears to be in the early stages, although several studies have examined factors that could be considered protective (e.g. social support, ethnic identity, parenting style) in influencing a single, average depression trajectory (Ge et al., 1994; Chen et al., 2011; Pettit et al, 2011).

In addition to being associated with various factors, longitudinal trajectories may, in turn, predict social, occupational, and psychological outcomes. Persons in the depressed

mood trajectories, unsurprisingly, fare worse than non-depressed counterparts. Except for one AddHealth study that identified worse physical health outcomes among theoretically-created depressed mood trajectories (Wickrama, Wickrama, & Lott, 2009), much of the work in examining outcomes has been done with the smaller school and community based samples. Thus, generalizability is limited.

Within a community-based sample of adolescents in Oregon, Yaroslavsky et al. (2014) found decreased social and personal resources and poor adjustment overall among depressed mood trajectories. They were more likely to be diagnosed with a depressive, anxiety, or substance use disorder. In addition, persons in a persistently elevated depression class were more likely to be separated or divorced even compared to individuals in a group with moderate but declining symptoms (Yaroslavsky et al., 2014). They also found that persons in the two depressed classes (i.e. moderate-decreasing and high stable) reported reduced educational attainment and lower annual household income compared to the non-depressed group. These findings are echoed in a study of Finnish university students followed over ten years noting reduced educational, occupational, and psychological functioning in adulthood; however, this study is limited as it only includes 206 individuals (Salmela-Aro et al., 2008).

Taken together, it appears that heterogeneous trajectories in emerging adulthood are associated with different predictors as well as different outcomes. Many of these correspond to factors identified in research focused on a single, average trajectory of depression symptoms across emerging adulthood. These include female gender, minority race or ethnicity, and factors associate with negative early experiences. Finally, individuals in

depressed mood trajectories generally experience reduced social and occupational attainment than non-depressed peers.

Limitations of current research. Research has primarily explored only a single trajectory of depression severity. Additionally, few longitudinal studies have continued to follow individuals as they continue through emerging adulthood, extending only through age 18 (Ge et al., 1994, Hankins et al., 1998) or age 22 (Frye & Liem, 2011). It is important to clarify the extent to which our understanding of adolescent depression symptoms corresponds and differs from depression symptom severity at later ages. While puberty has been completed by the emerging adult period, biological changes continue to play a role in development as the brain continues to develop through this period (Sowell, Peterson, Thompson, Welcome, Henkenius, & Toga, 2003). Social and psychological factors are likely to play a more central role, however, as emerging adults take on the responsibilities of adulthood and often leave their families of origin. Likely due to the emphasis on adolescence, there has been a tendency to focus on variables from early childhood or that are relevant across developmental periods, such as childhood adversity or stressful life events (Wickrama, et al., 2008; Meadows et al., 2006). Some factors are likely to continue to be important in understanding depressive symptoms in emerging adulthood, but there is some evidence that these factors may weaken or change in their effect over time (Galambos et al., 2005). In addition, other factors may become more relevant for this developmental context.

As noted, some work has been done to examine subgroups hypothesized to be at increased risk of depression, such as females (Ge et al., 1994; Hankin et al., 1998); however, these are limited to exploring quantitative, rather than qualitative, differences in trajectories. There are several reasons to suspect the presence of multiple, distinct trajectories of

depressive symptoms, which may first present in adolescence and continue through the emerging adult period. Although the vast majority of youths do not develop clinical depression, a subset will. For some, this may develop into persistent depression (Klein, 2008). Including all in a single trajectory group may create a misleading picture if a subset of moderately or severely depressed individuals raises the overall average. This also may misrepresent that the majority of adolescents who do not report any depressed mood during the transition to adulthood (Costello et al., 2008).

Moreover, emerging adulthood is characterized by dynamic influences on social and emotional development as well as a shifting interpersonal context (Arnett, 2000). Biological, social, and psychological factors influence the course of depressive symptoms through adolescence (Cicchetti & Toth, 1998). Reflecting this, a growing body of research has begun to explore whether a consistent set of trajectories of depression symptom can be identified in adolescence and later (e.g. Chaiton et al., 2013; Costello et al., 2008). Indeed, evidence suggests that there are multiple, distinct patterns of depressive symptoms in adolescence and these are predictive of psychosocial outcomes in adulthood (Chaiton et al., 2013). These heterogeneous patterns may extend into emerging adulthood as trajectories are dissimilar at the end of adolescence (Chaiton et al., 2013). Thus, it will be important to consider whether a consistent set of trajectories emerges from the literature and how this might inform future clinical work and research.

Drawing conclusions about emerging adulthood has been hampered by lack of attention to this developmental period. Emerging adulthood is a diverse and dynamic period as individuals take on new responsibilities of adulthood yet are often not yet fully independent (Arnett, 2000; Arnett, 2007). Therefore, study of this specific developmental

context is necessary. Much of the research on this has focused on how depressive symptoms severity fluctuates over this period on average, with examination of factors affecting severity within this single trajectory. However, this course may be influenced by subgroups that make this average trajectory less representative of the individual members of the population.

Therefore, it is necessary to move beyond an average trajectory to explore multiple subgroups of individuals with similar trajectories over time. By identifying those individuals at risk for depressive symptoms that are persistent or escalating through the emerging adult period, more effective interventions may be offered. In addition, by recognizing that the transition to adulthood is generally positive in terms of minimal or declining depressive symptoms, there may be greater recognition of problematic symptoms warranting intervention when they do occur. In addition to the lack of attention to this developmental period, methodological differences in terms of research design, analytic method, and sampling characteristics further contribute to disparate findings.

Current Study

Overall, there is evidence that depression severity decreases during the transition to adulthood when averaged across the population (Adkins et al., 2009; Galambos et al., 2006; Hankin et al., 1998; Natsuaki et al., 2009). Depression symptom severity also tends to decrease even among subgroups of individuals reporting higher overall levels, such as females, minority individuals, or individuals with chronic illness (Adkins et al., 2009; Ferro et al., 2015a). Although emerging adulthood is associated with changing social support networks and increasing responsibilities (Arnett, 2007; Cohen et al., 2003), most individuals cope quite well. Indeed, it is possible that individuals benefit from taking on new challenges and exerting more control over their lives. For many individuals, they take on these

responsibilities in a gradual fashion. Parents, peers, and institutions may also provide assistance (Dyson & Renk, 2006).

However, there is a burgeoning literature that there are multiple trajectories of depression symptoms across emerging adulthood differing in the severity and stability of symptoms over time (Adkins et al., 2009; Costello et al., 2008; Frye & Liem, 2011; Wickrama et al., 2010). A single trajectory appears to diverge into multiple trajectories in adolescence, and these continue through age 25 (Costello et al., 2008; Hankin et al., 1994; Galambos et al., 2006). Though the majority of individuals report very low symptom levels throughout the transition to adulthood (Adkins et al., 2009; Costello et al., 2008; Frye & Liem, 2011), some individuals report elevated levels of depression at some point in emerging adulthood (Costello et al., 2008; Stoolmiller et al., 2005; Yaroslavsky et al., 2014). Looking only at a *single* average trajectory obscures this and suggests that a higher level of depression at the onset of adulthood is normative. Instead, it may be that this “bump” in depression symptoms may be driven by a subset of individuals who first experience more severe symptoms in late adolescence which continues into emerging adulthood. When multiple trajectories are considered, the largest group identified endorses minimal depression symptoms at the beginning and throughout emerging adulthood (Adkins et al., 2009; Costello et al., 2008; Frye & Liem, 2011; Yaroslavsky et al., 2014).

Specific Aims and Hypotheses

Using a sample of 9,891 participants drawn from the “Spit for Science” project (Dick et al., 2011), the goal of the present study was to examine trajectories of depressive symptoms in college students, a subset of emerging adults. Addressing this question offers additional insight into how depressive symptoms emerge and unfold across college, whether

classes with distinct trajectories emerge, and what factors may influence these trajectories. Specifically, this study has four main aims: (1) examine whether multiple trajectories of depressive symptoms are present in emerging adulthood; (2), identify risk factors that distinguish among trajectories and increase risk of belonging to a depressed mood trajectory; (3) identify protective factors associated with experiencing minimal to mild depressive symptoms across emerging adulthood; and (4) connect depressive symptom trajectories to health behaviors. Based on the current literature regarding emerging adult patterns of depression symptoms and factors that influence these, the following hypotheses were explored.

Aim 1: To examine whether multiple heterogeneous trajectories of depressive symptoms are present across ages 18-25.

Hypothesis 1: Four trajectories of depressive symptoms will be found across ages 18-25: Low/Minimal, Increasing, Decreasing, and Chronically Elevated.

Aim 2: To identify risk factors that distinguish amongst trajectories of depressive symptoms in emerging adulthood.

Hypothesis 2: Female sex will increase the likelihood of belonging to a depressed mood trajectory (i.e. increasing, decreasing, and chronically elevated trajectories).

Hypothesis 3: Identifying as a member of a diverse racial or ethnic group will increase the likelihood of belonging to a depressed mood trajectory (i.e. increasing, decreasing, and chronically elevated trajectories).

Hypothesis 4: Identifying as lesbian, gay, or bisexual will increase the likelihood of belonging to a depressed mood trajectory (i.e. increasing, decreasing, and chronically elevated).

Hypothesis 5: Experiencing a greater number of lifetime stressful events will be associated with increased likelihood of belonging to a depressed mood trajectory (i.e. increasing, decreasing, and chronically elevated trajectories).

Aim 3: To identify potential protective factors that decrease likelihood of membership in a depressed mood trajectory.

Hypothesis 6: Higher social support will increase likelihood of membership in the low/minimal depression trajectory.

Hypothesis 7: Greater self-reported resilience will increase likelihood of membership in the low/minimal depression trajectory.

Aim 4: Connect depressed mood trajectories to health behaviors.

Hypothesis 8: Persons in the chronically depressed mood group will report greater frequency and quantity of alcohol consumption compared to the low/minimal depression trajectory.

Hypothesis 9: Persons in the increasing and chronically depressed mood groups will be more likely to use nicotine and exhibit higher levels of nicotine dependence compared to the low/minimal depression trajectory.

Hypothesis 10: Persons in the increasing and chronically depressed mood groups will be more likely to engage in risky sexual behaviors compared to the low/minimal depression trajectory.

Method

Data Set

The data used was collected as part of the “Spit for Science” project. This project was funded by the National Institute on Alcohol Abuse and Alcoholism (NIAA; Dick & Kendler,

NIH R37 AA011408). Spit for Science is a longitudinal study of undergraduate students attending a public university on an urban campus. The overarching purpose of Spit for Science is to examine factors related to alcohol use and abuse, use of other substances, and emotional health. This study included environmental, developmental, and genetic influences. Although predominantly consisting of questions about alcohol and substance use, this study also included measures about mental health, personality, previous life experiences, and other behaviors. This study is notable also in that (saliva) DNA samples were collected in order to examine genetic influences on the etiology of alcohol and other psychological disorders. Please refer to Dick et al. (2014) for a full description of the project and procedures.

In order to ease participant burden and giving the large-scale and wide-ranging nature of the study, measures were necessarily abbreviated. Items were retained for discrimination along the latent factor scale or dropped due to redundancy after review of results of item response model fitting.

Study Procedures

The study was reviewed and approved by the university Institutional Review Board. Initial recruitment for the first cohort began two weeks prior to freshman arrival to campus in Fall 2011, with three subsequent cohorts being recruited in Fall 2012, 2013, and 2014. Information about the study was mailed to all incoming freshmen and (separately) their parents two weeks before freshmen were scheduled to arrive on campus. Then, all eligible freshmen (first time freshmen aged 18 years and older) were sent an email invitation to participate the week before freshman “Welcome Week.” Reminders were sent by emails to students who did not respond to the initial invitation (i.e. either agreeing or declining to participate in the study). In addition, flyers were placed around campus with details about

participating. All students who initiated the study survey were first led to a consent process including an explanation of the study and their participation.

Participants were then invited to complete annual follow up surveys during subsequent Spring semesters in 2013, 2014, 2015, and 2016. They were notified by mail of the continuing data collection. E-mail invitations were then sent with links to the online survey. Again, students were led through a consent process when they initiated the online survey. All online surveys (initial and follow-up) were designed to take approximately 15-30 minutes to complete. Participants were compensated \$10 for their participation in each part of the study, which was collected at a central university site. Participants were also asked for a saliva DNA sample for analyses related to other study aims, although this information is not used in the current study.

Participants.

The sample included participants in the four cohorts who completed the Freshman baseline survey and at least one follow-up survey. The sample was predominantly female (61.1%) and non-Hispanic White (49.4%). See Table 2 for additional information regarding participant characteristics.

Table 2.

Participant Descriptive Characteristics

Variable	<i>n</i> (%)	<i>Mean</i> ± <i>SD</i>
Age*	--	18.50 ± 0.43
Sex		
Male	3,779 (38.2%)	--
Female	6,040 (61.1%)	--
Missing/Chose not to answer	70 (0.7%)	--
Sexuality‡		
Heterosexual	3,259 (89.9%)	--
Lesbian or gay	131 (3.6%)	--
Bisexual	237 (6.5%)	--
Race/Ethnicity		
American Indian/Alaska Native	51 (0.5%)	--
Asian	1,614 (16.3%)	--
Black/African American	1,873 (18.9%)	--
Hispanic/Latino	594 (6.0%)	--
More than one race	617 (6.2%)	--
Native Hawaiian/Other Pacific Islander	67 (0.7%)	--
Unknown	39 (0.4%)	--
White, non-Hispanic	4881 (49.4%)	--
Missing/Chose not to answer	153 (1.5%)	--

Note. **N* = 7910, ‡*n* = 3627

Measures

Demographics. Demographic variables for the present study included age, sex (male or female), sexual orientation (heterosexual, homosexual, and bisexual) and race/ethnicity (American Indian/Alaska Native, Asian, Black/African-American, Latino/a, More than one race, Native Hawaiian/Other Pacific Islander, and non-Hispanic White).

Depressive Symptoms. The Symptom Checklist-90 Short Version (Hardt & Gerbershagen, 2001) is a 27-item self-report measure of psychological symptoms. Four items assessed depression symptoms. Responses were provided on a 5-point Likert scale, with responses ranging from 1 (*not at all*) to 5 (*extremely*). Although there is some dispute in the literature about the overall factor structure of the SCL-90 (e.g. Cyr, 1985), the depression

scale has been shown to have good convergent and divergent validity (Koeter, 1992; Morgan, Wiederman, & Magnus, 1998). Depression symptoms were modeled across the four years of college as this measure was collected at baseline and at each follow-up survey every Spring. Items are summed such that higher scores indicate more severe symptoms.

Risk Factors. Participants completed a checklist of potential stressful life events during each survey based on a checklist of twelve stressful life events used in prior research (Kendler, Karkowski, & Prescott, 1999). Events included ending a relationship, illness or injury to self or loved ones, losing a job, and others. In the initial survey, participants rated whether these had ever occurred. In follow-up surveys, participants were asked to rate whether these had occurred since starting college (for the follow-up survey in spring of the Freshman year) or in the past year (for all follow-up surveys thereafter). A sum score of lifetime stressful events was used.

Protective Factors. Participants completed the Conner-Davidson Resilience Scale (CD-RISC), a 2-item measure of a person's ability to "bounce back" from difficult times (Connor & Davidson, 2003). Participants rated each item on a scale of 0 (*Not at all true*) to 4 (*True nearly all the time*). A sum score was computed, with higher scores indicating higher levels resilience. This measure was completed during the Freshman year new survey and was available for the first three cohorts.

Participants responded to three items assessing their perceptions of the availability of social support (Hays, Sherbourne, & Mazel, 1995). Participants rated how often someone was available to give good advice for a crisis, to get together with for relaxation, and to confide in or talk about problems, on a scale from 1 (*None of the time*) to 4 (*All of the time*).

This measure was collected during each assessment, but the response for Fall Freshman year was used in this study. Responses to the three items were summed to create a total score.

Health Behaviors. Participants completed items regarding health behaviors including alcohol use, nicotine use, and sexual behavior. A single item assessed alcohol use frequency at each assessment. Participants selected their use of alcohol from the following options: *Never, Monthly or less, Two to four times per month, Two to three times per week, or Four or more times per week.* Participants also provided their typical quantity of alcohol consumption: 1-2, 3-4, 5-6, 7-9, or 10+. If participants had previously indicated they had never consumed alcohol, their response was automatically set at zero. Participants' alcohol use Senior year was used for the present analyses.

Respondents provided information on their tobacco use at each assessment, including total number of cigarettes smoked in their lifetime. Participants also provided information on how frequently they had smoked cigarettes in the last 30 days. At each survey, participants who indicated using nicotine products completed the Fagerstrom Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Freckers, & Fagerstrom, 1991). This six item measure assessed symptoms of dependence including timing of first cigarette upon waking, difficulty refraining from smoking, and smoking more early in the day. Higher scores indicate greater dependence on nicotine. Senior year nicotine use and dependence was used.

Six items assessed risky sexual behaviors during the Junior and Senior Follow-up Survey; the Senior year score was used in the current study. Four items inquired about the previous three months: the number of sexual partners, frequency of unprotected sex, frequency of sexual contact while using substances other than alcohol, and frequency of sexual contact while using alcohol. Participants were also asked their age of first sexual

contact and whether they had used a condom during their last sexual encounter. A sum score was computed by assigning a point for the following behaviors: having sex with three or more people, having unprotected sex once or more, having sex while intoxicated at least once, having sex for the first time before age 13, and not using a condom during the last sexual experience. Resulting scores ranged from 0 to 5, with higher scores indicating more risky behavior (Center for Disease Control and Prevention, 2013).

Data Analysis

Statistical analyses were performed using SPSS v.25.0 (SPSS, Chicago, IL) and MPlus v8 (Muthén & Muthén, 1998-2018).

Data preparation. Prior to analysis, descriptive statistics were calculated for variables: frequency counts for categorical variables and means and standard deviations for continuous variables.

Missing data. A feature of MPlus (Muthén & Muthén, 1998-2018) is that it incorporates full information maximum likelihood estimation to include all available cases, including those with missing data.

Statistical analyses. Growth Mixture analyses were conducted to using Mplus software version 8 (Muthén & Muthén, 1998-2018) to identify classes of depressive symptom trajectories over the four years of college and predictors and correlates of class membership. Growth mixture modeling allows for identification of trajectories that differ both in quality and kind (Bauer & Reyes, 2010). That is, both between-group and within-group differences may be explored.

To accomplish this, a series of models were fitted find the model that best fit the overall data without identifying multiple classes. First, a baseline model for comparison was

established. Latent Growth Curve Models (LGCM) evaluate longitudinal change in terms of initial level (intercept) and change (slope, quadratic term, and/or cubic term) to describe individual differences in growth over time. That is, a single trajectory of depression symptoms was modeled to describe how symptoms fluctuate across the college years, including both Fall and Spring of Freshman year and Spring semesters through the fourth year of college, combining data across multiple cohorts. Latent growth models were estimated to determine the shape that best fit the data, including no growth, linear, quadratic, and cubic models. Once the latent growth model was established, it was used to as a baseline for comparison for the Growth Mixture Models. Fit indices included the root mean square error of approximation (RMSEA), comparative fit index (CFI), and the Tucker-Lewis index (TLI). RMSEA values less than .06 and CFI and TLI values above .95 are considered indicators of good fit (Hu & Bentler, 1999).

Next, Growth Mixture Models (GMMs) were used to test the study's hypotheses aims regarding whether multiple trajectories of depression symptoms could be identified during college. Growth Mixture Modeling groups individuals based on similar patterns of change while also allowing for exploration of individual differences within these groups (Jung & Wickrama, 2008). Within this study, models of multiple subgroups of individuals with similar levels of and change in depression symptoms across four years of college were explored. To accomplish this, a series of GMMs were fitted to determine whether distinct groups can be identified for depressive symptoms across college. To determine the appropriate number of classes, a series of GMMs were specified until no improvement or worsening fit was found, with at least one model exceeding the expected number of classes by one. As the number of classes was hypothesized to be four based on previous literature, 2-

class, 3-class, 4-class, and 5-class models were specified, with the shape of the trajectory (linear, quadratic, or cubic) informed by the results of the LGCMs.

Models based on increasing number of classes were compared to the baseline and to each other. In determining the optimal number of classes in these models, various fit statistics were considered, including the Vuong-Lo-Mendell-Rubin (VLMR) likelihood ratio test. The VLMR compares the fit of a current model with K classes to that of a model with one fewer class ($K-1$ classes), with better fit indicated by a significant p-value. Classes were increased until the tests result in non-significance. Additional fit statistics included the AIC and BIC, with lower values of coefficients indicating better fit. As recommended by Jung & Wickrama (2008), higher entropy values were preferred, along with all proportions for the latent classes are all above .01 or 1%. Finally, interpretability of the model and consistency with theory ultimately determined model selection based on both inspection of model plots and proportions of the sample within each class.

Next, the 3-step method (Asparouhov & Muthén, 2014) for exploring auxiliary variables within growth mixture analyses was used to examine predictors and correlates of class membership. This allowed for exploration of predictors of latent depressed group distributions without affecting the classes themselves. This method was used to explore the second and third aims in order to better understand how trajectories may be associated with potential risk and protective factors. Finally, the influence of trajectory on Senior Year health behaviors including nicotine use and dependence, alcohol use quantity and frequency, and risky sexual behaviors were examined using one-way analyses of variance.

Results

Descriptive Statistics

The means and standard deviations of SCL-90 depression score at each time point are reported in Table 3 and broken out by wave for comparison among cohorts. As can be seen in Table 3, there is generally an increase in depression symptoms from the Fall to Spring of Freshman year and a decrease in subsequent years. Descriptive statistics for additional variables used in the analyses are presented in Tables 4 and 5.

Table 3.

Means and Standard Deviations for SCL-90 Depression Score by Wave

	Freshman Intro	Freshman New or Follow-up	Sophomore Follow-up	Junior Follow-up	Senior Follow Up
Overall	8.74(3.70) <i>n</i> =7787	9.76(3.92) <i>n</i> =7386	9.49(4.04) <i>n</i> =4685	9.52(4.05) <i>n</i> =3712	9.37(4.03) <i>n</i> =2340
Wave 1	8.17(3.59) <i>n</i> =1997	9.69(3.78) <i>n</i> =2133	9.29(4.01) <i>n</i> =1297	9.22(3.83) <i>n</i> =967	9.31(4.03) <i>n</i> =850
Wave 2	8.81(3.61) <i>n</i> =1979	9.57(3.92) <i>n</i> =1885	9.73(3.99) <i>n</i> =1182	9.47(4.17) <i>n</i> =951	9.40(4.07) <i>n</i> =748
Wave 3	9.01(3.69) <i>n</i> =2003	9.87(3.93) <i>n</i> =1701	9.51(4.04) <i>n</i> =1154	9.39(4.03) <i>n</i> =953	9.41(4.00) <i>n</i> =742
Wave 4	8.99(3.86) <i>n</i> =1808	9.95(4.07) <i>n</i> =1667	9.45(4.11) <i>n</i> =1052	10.09(4.13) <i>n</i> =841	--

Note. SCL-90 score range 4-20. Wave 1 data collection began in Fall 2011, Wave 2 in Fall 2012, Wave 3 in Fall 2013, and Wave 4 in Fall 2014.

Table 4.

Descriptive Statistics of Auxiliary Variables Used in 3-Step Procedure

Variable	<i>n</i> (%)	<i>Mean</i> ± <i>SD</i>
Sex		
Male	3793 (38.3%)	--
Female	6061 (61.3%)	--
Missing	37 (0.4%)	
Race/Ethnicity		
White, non-Hispanic	4881 (49.3%)	--
Minority/non-White	4855 (49.1%)	--
Missing	155 (1.6%)	--
Sexual Orientation		
Heterosexual	5468 (55.3%)	--
Sexual minority	864 (8.7%)	--
Missing	3559 (36.0%)	--
Lifetime stressful events (LSE)	--	4.86 ± 5.48
Resilience	--	6.12 ± 1.49
Social support	--	5.85 ± 2.30

Note. *N*=9,891. A large proportion of the sample did not have a response given for sexual orientation. This could be due to participants choosing not to respond to this item, not completing a survey in which this question was asked, or another reason.
Missing data for continuous variables (*n* [%]): LSE (70 [0.7%]), Resilience (2387 [24.1%]), Social Support (2750 [27.8%])

Table 5.

Descriptive Statistics of Senior Year Health Behaviors

Variable	Frequency (Percent)	Mean \pm SD
<i>Alcohol Use Senior Year</i>		
Alcohol use frequency		
Never	115 (1.2%)	--
Monthly or less	622 (6.4%)	--
2-4 times per month	787 (8.0%)	--
2-3 times per week	560 (5.7%)	--
4 or more times per week	123 (1.3%)	--
Missing	7575 (77.4%)	--
Alcohol use quantity		
1-2 drinks	800 (8.2%)	--
3-4 drinks	783 (8.0%)	--
5-6 drinks	349 (3.6%)	--
7-9 drinks	115 (1.2%)	--
10+ drinks	33 (0.3%)	--
Missing	7702 (78.7%)	--
<i>Nicotine Use Senior Year</i>		
Cigarette frequency (last 30 days)		
None	672 (6.9%)	--
Once or twice	171 (1.7%)	--
3-4 days per month	60 (0.6%)	--
5-11 days per month	41 (0.4%)	--
12-14 days per month	20 (0.2%)	--
15-25 days per month	35 (0.4%)	--
26-30 days per month	87 (0.9%)	--
Missing	8696 (88.9%)	--
Nicotine dependence*	--	0.50 \pm 1.32
Risky sexual behaviors Senior Year**	--	1.18 \pm 1.15
<i>Note.</i> *Missing=8381 (85.7%). **Missing=7510 (76.8%)		

Latent Growth Curve Model

Aim 1, Determining whether multiple heterogeneous trajectories of depressive symptoms are present during college: In order to address the first aim of the study, it was necessary to first determine the shape of growth curves that best represented changes in depression symptoms over time. Missing data were handled with full information maximum likelihood analysis, which included all cases with at least one wave of data.

The estimation of the unconditional growth model involved comparing the fit of various models that differed in the shape of growth over time including (a) an intercept-only model assuming levels of depression symptoms could be represented by an overall mean, (b) a linear growth model that represented change in depression symptoms over time as a function of the intercept, or level of depression symptoms at time 1 (Fall Freshman year), and a linear slope coefficient representing change across time, (c) a quadratic model that represented change in depression symptoms over time as a function of an intercept, a linear slope coefficient, and a quadratic coefficient representing curvilinear change across time, and (d) a cubic model that represented change in depression symptoms over time as a function of an intercept, a linear slope coefficient, a quadratic coefficient, and a cubic coefficient. The unconditional growth models did not include covariates. See Table 6 for information about fit indices for the LGCMs.

Table 6.

Summary of Latent Growth Curve Models

Model	χ^2	Df	<i>P</i>	CFI	TLI	RMSEA
Intercept-only	938.40	14	<0.001	0.87	0.90	0.09
Linear	584.18	10	<0.001	0.92	0.92	0.08
Quadratic	332.33	6	<0.001	0.95	0.92	0.08
Cubic	121.09	1	<0.001	0.98	0.83	0.11

Note. CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation.

Review of relevant fit indices, presented in Table 6, supported the quadratic LGCM as evidenced by improving CFI, TLI, and RMSEA from intercept-only, to linear, and to quadratic. However, the addition of a cubic term resulted in a larger RMSEA value, with a value above the recommended cutoff of .08, and thus considered problematic (Jung & Wickrama, 2008). Therefore, the quadratic model was deemed to be the best-fitting model

for the data. A quadratic function also fit with previous research and theory suggesting a curvilinear pattern of increasing, then decreasing, depression symptoms over adolescence and into emerging adulthood (Ferro et al., 2015b; Natsuaki et al., 2009).

Growth Mixture Models

In order to address the first aim of the study, a series of growth mixture models was examined for depression symptoms, with each additional model specifying an increasing number of classes, and to examine whether models with multiple classes improved on the Latent Growth Curve Models described in the previous sections. These analyses were conducted to determine whether individual differences in growth parameters for each model could be described by identifying clusters of individuals with similar patterns of change in depression symptoms over time. To this end, depression severity at each wave from the Fall of Freshman year (Freshman Intro Survey) to Spring of Senior year (Senior Follow-up survey) was entered into a mixture model. This was accomplished using the MLR estimator and 20 random starts. The MLR estimator is a maximum likelihood parameter estimate that is robust to non-normality of the data. Random starts are sets of starting points, chosen at random, when sampling from a given population.

Model specification is an exploratory process, beginning with less complex models and adding additional classes and parameters. Briefly, based on the result from the LGCM supporting a quadratic model, these were the initial models examined. Initially, all parameters (intercept, slope, and quadratic term) were allowed to vary freely; however, this resulted in multiple warnings. Recommendations from Jung & Wickrama (2008) are to limit model complexity to reduce computation time, convergence issues, spurious solutions and

model instability by constraining parameters. Thus, exploration was done with constraining the variance of the slope and quadratic term at 0.

Table 7.

Quadratic Growth Mixture Model Comparisons

Classes	AIC	BIC	VLMR	VLMR <i>p</i>	Entropy	Smallest Class
2	136851.05	136937.32	1026.95	<.001	0.40	44.3%
3	135811.98	135948.57	829.37	<.001	0.50	21.1%
4	135558.76	135731.30	263.21	<.001	0.52	2.8%
5*	135242.31	135493.91	135.41	0.0153	0.46	2.9%

Note: Only the intercept was allowed to vary in these models. The slope and quadratic parameter variances were constrained at 0. Although models with freed intercept and slope were explored, these resulted in PSI warnings and thus not eligible for consideration.

*PSI warning produced, indicating that the covariance matrix is not positive-definite

^aBased on most likely class

In examining increasingly complex GMM with quadratic terms with only intercept allowed to vary, 4-class solution was preferred over previous models given improving fit indices and no class smaller than 1% of sample. See Table 7 for these statistics for each class. The more complex, 5-class solution was rejected given non-positive definite PSI matrix, indicating an untrustworthy model. Given this, the 5-class and models with additional classes were not considered. More complex models where the intercept and slope were allowed to vary were also explored, but these also resulted in a non-positive definite PSI matrix; thus, these models were not retained. As part of the model building process, less complex models including 2-5 class GMM with only linear terms, along with more complex models also including cubic terms were also explored; however, these did not improve on the 4-class quadratic GMM. See Appendix for information on these other models explored.

Based on these factors, the 4-class quadratic model with both slope and quadratic variance constrained to zero was further evaluated. To accomplish this, values predicted by

the function describing each class were plotted and compared to the observed values. That is, Mplus was used to generate the most likely class for each subject. Then, computed the average depression score for each class at each time point (Freshman fall, Freshman spring, and so on) and compared this to the values predicted by the function for each class.

Table 8.

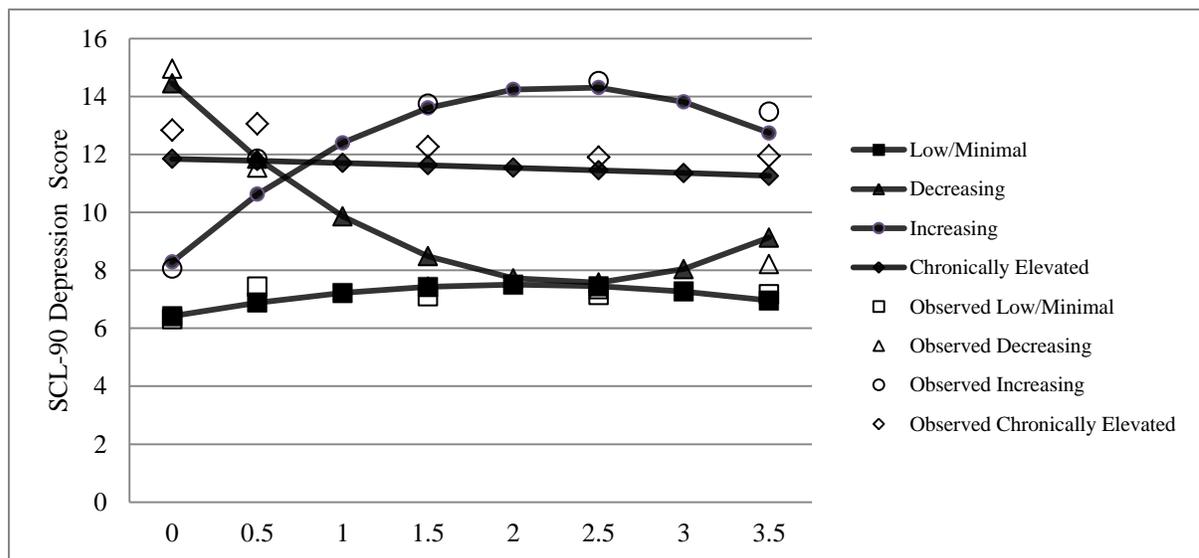
4-Class Quadratic Growth Mixture with Free Intercept

Class	Intercept <i>M</i> (SE)	Intercept Variance (SE)	Slope <i>M</i> (SE)	Quadratic <i>M</i> (SE)	Proportion of sample (MLC)
1	6.43* (0.09)	0.85* (0.11)	1.06* (0.09)	-0.26* (0.03)	55.9%
2	14.46* (0.34)	4.11* (6.80)	-5.82* (0.56)	1.24* (0.16)	2.8%
3	8.29* (0.13)	3.05* (0.23)	5.25* (0.30)	-1.14* (0.09)	11.6%
4	11.85* (0.21)	8.62* (0.28)	-0.13 (0.25)	-0.01 (0.07)	29.7%

Note. *M*=Mean, SE= Standard Error, MLC= most likely class
**p*<.001

Figure 1.

Comparison of Values Predicted by 4-Class Quadratic GMM and Observed Means



Consistent with Hypothesis 1, four trajectories of depressive symptoms were found across the four years of college. For ease of discussion, these are referred to as

“Low/Minimal Depression,” “Decreasing,” “Increasing,” and “Chronically Elevated.” See Table 8 for specific information about each class including intercept, slope, and quadratic estimates. The most common trajectory, including 55.9% of the sample, is referred to as the *Low/Minimal* depression group, and was characterized by lower depression levels across the four years of college. Second, a *Chronically Elevated* group (29.7%) evinced elevated, though slightly declining, symptoms over time. Third, 11.6% of the sample was characterized by increasing depression symptoms (*Increasing*), with initially similar levels to those in the *Low/Minimal* depression group though a steep increase in depression followed by decreasing symptoms after Junior year. Finally, 2.8% of the sample was described by a decreasing trajectory (*Decreasing*), characterized by initially high level of depressions that declined over the first two years of college to be similar to those in the *Low/Minimal* depression group by Senior year. As predicted in Hypothesis 1, the largest group was a class with consistently low depression symptoms across the four years of college. However, a substantial number, nearly 45%, of students belonged to one of the depressed mood trajectories, including more than one-quarter of individuals belonging to the Chronically Elevated group.

Table 9.

Descriptive Statistics of Trajectory Groups

	Low/Minimal <i>n</i> =5465	Decreasing <i>n</i> =278	Increasing <i>n</i> =1137	Chronically Elevated <i>n</i> =2904
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Sex				
Male	2205 (40.3%)	106 (38.1%)	390 (34.3%)	1032 (35.5%)
Female	3240 (59.3%)	172 (61.9%)	744 (65.4%)	1861 (64.1%)
Missing	20 (0.4%)	0 (0%)	3 (0.3%)	11 (0.4%)
Race/Ethnicity				
White, non-Hispanic	2725 (49.9%)	146 (52.5%)	555 (48.8%)	1369 (47.1%)
Minority/non-White	2645 (48.4%)	127 (45.7%)	568 (50.0%)	1502 (51.7%)
Missing	95 (1.7%)	5 (1.8%)	14 (1.2%)	33 (1.1%)
Sexual Orientation				
Heterosexual	3038 (55.6%)	32 (11.5%)	143 (12.6%)	270 (9.3%)
Sexual minority	411 (7.5%)	182 (65.5%)	703 (61.8%)	1512 (52.1%)
Missing	2016 (36.9%)	64 (23.0%)	291 (25.6%)	1122 (38.6%)
	<i>Mean ± SD</i>	<i>Mean ± SD</i>	<i>Mean ± SD</i>	<i>Mean ± SD</i>
Lifetime stressful events (LSE)	4.62 ± 5.50	5.72 ± 5.97	5.67 ± 5.86	4.96 ± 5.20
Resilience	6.25 ± 1.45	5.74 ± 1.69	6.18 ± 1.40	5.90 ± 1.56
Social support	6.74 ± 2.20	5.82 ± 2.52	6.54 ± 2.13	6.15 ± 2.32

Growth Mixture Models with Auxiliary Variables

To accomplish the second aim of the study, auxiliary variables were then added to the 4-class linear GMM using the R3step procedures outline by Asparouhov & Muthen (2013). This method is recommended as it avoids some of the drawbacks of other methods of exploring the relationship between classes and other, observed auxiliary variables of interest. Specifically, auxiliary variables do not affect latent class formation. Simulation studies also demonstrate that the 3-step method is also preferred when class separation is reduced, such as when entropy is below 0.6 (Asparouhov & Muthen, 2013), as in this study.

Using the 3-step method, auxiliary predictor variables were included and treated as latent class predictors. These variables included sex (male vs. female), race/ethnicity (white

vs. Minority/non-White), sexual orientation (heterosexual vs. lesbian, gay, or bisexual [LGB]), lifetime stressful events, social support, and resilience. See Table 10 for results.

Table 10.

Predictors of Group Membership: Low/Minimal Depression Group vs. Others

Variable	<i>Decreasing vs. Low/Minimal OR (95% CI)</i>	<i>p value</i>	<i>Increasing vs. Low/Minimal OR (95% CI)</i>	<i>p value</i>	<i>Chronically Elevated vs. Low/Minimal OR (95% CI)</i>	<i>p value</i>
<i>Gender</i>						
Male	Reference		Reference		Reference	
Female	1.70 (1.07-2.70)	0.025	1.68 (1.22-2.32)	0.002	2.83 (1.61-4.99)	<.001
<i>Race/Ethnicity</i>						
White	Reference		Reference		Reference	
Minority/non-White	1.33 (0.85-2.08)	0.208	0.93 (0.69-1.26)	0.639	0.68 (0.42-1.11)	0.125
<i>Sexual Orientation</i>						
Heterosexual	Reference		Reference		Reference	
LGB	1.53 (0.74-3.17)	0.249	2.19 (1.41-3.40)	<.001	3.50 (2.01-6.11)	<.001
<i>LSE</i>	1.04 (1.01-1.07)	0.003	1.04 (1.02-1.07)	<.001	1.04 (1.01-1.07)	.019
<i>Resilience</i>	0.50 (0.43-0.59)	<.001	0.76 (0.67-0.85)	<.001	0.56 (0.48-0.66)	<.001
<i>Social Support</i>	0.69 (0.63-0.77)	<.001	0.78 (0.72-0.84)	<.001	0.63 (0.57-0.71)	<.001

Note: LGB=Lesbian, Gay, or Bisexual; LSE= Lifetime stressful events

Aim 2, Risk factors for belonging to depressed mood trajectories: The second aim of this study was to identify risk factors that distinguish among trajectories of depressive symptoms in emerging adulthood. Odds ratios (OR) and confidence intervals (CI) for each variable explored are presented in Table 10, comparing each of the depressed mood trajectories to the Low/Minimal group (i.e. the reference group).

Hypothesis 2 was supported. Female sex was associated with increased likelihood of belonging to any of the depressed mood trajectories compared to the *Low/Minimal* depression group, (*Decreasing*: 1.70, 95% CI 1.07-2.70, $p=.025$; *Increasing*: OR 1.68, 95% CI 1.22-2.32, $p=.002$; *Chronically Elevated*: OR 2.83, 95% CI 1.61-4.99, $p<.001$).

Contrary to Hypothesis 3, race/ethnicity was not significantly associated with trajectory as students identifying as minority race/ethnicity did not have increased likelihood

of belonging to depressed mood trajectories (*Decreasing* class: OR 1.33, 95% CI 0.85-2.08, $p=.208$; *Increasing* class: OR 0.93, 95% CI 0.69-1.26, $p=.639$; *Chronically Elevated*: OR 0.68, 95% CI 0.42-1.11, $p=0.125$). Of note, analyses including more specific diverse racial and ethnic groups (e.g. American Indian/Alaska Native, Asian, Black/African-American, Latino/a, Asian/Pacific Islander) were also not significantly associated with depressed mood trajectories.

Hypothesis 4 was partially supported, as identification as lesbian, gay, or bisexual was associated with increased likelihood of belonging to either the *Increasing* (OR 2.19 95% CI 1.41-3.40, $p<.001$) and *Chronically Elevated* classes (OR 3.50, 95% CI 2.01-6.11, $p<.001$) compared to the *Low/Minimal* depression trajectory; however, this effect was not found for the *Decreasing* class (OR 1.53, 95% CI 0.74-3.17, $p=.25$).

Compared to the *Low/Minimal* depression class, experiencing a greater number of stressful life events was associated with belonging to all three depressed mood trajectories: the *Decreasing* (OR 1.04, 95% CI 1.01-1.07, $p=.003$), *Increasing* (OR 1.04, 95% CI 1.02-1.07, $p<.001$), and *Chronically Elevated* (OR 1.04, 95% CI 1.01-1.07, $p=.019$) classes. Although these effects were each statistically significant, each additional stressful life event endorsed increased the likelihood of belonging to depressed mood trajectories by only 4%.

Aim 3, Protective factors against belonging to depressed mood trajectories:

Potential protective factors were evaluated in the third aim of this study, with support found for both Hypotheses 6 and 7. Results are also presented in Table 7. Self-reported resilience decreased the likelihood of belonging to *Decreasing* (0.50, CI 0.43-0.49, $p<.001$), *Increasing* (OR 0.76, 95% CI 0.67-0.85; $p<.001$), and *Chronically Elevated* (OR 0.56, CI 0.48-0.66, $p<.001$), trajectories; however, inspection of the odds ratio shows this effect is larger for the

Decreasing and *Chronically Elevated* trajectories, with the risk of belonging to either decreased by approximately 50% for every one unit increase in resilience. Similarly, social support decreased the likelihood of belonging to any of the depressed mood trajectories compared to the *Low/Minimal* depression group: *Decreasing* (OR 0.69, CI 0.63-0.77, $p < .001$), *Increasing* (OR 0.78, CI 0.72-0.84, $p < .001$), and *Chronically Elevated* (OR 0.63, CI 0.57-0.71, $p < .001$).

Aim 4, Connecting depressed mood trajectories to health behaviors: The final aim was to examine whether trajectory groups differed in terms of nicotine use, alcohol use, and risky sexual behaviors. Individuals were classified according to their most likely class by based on their probability of belonging to each trajectory group in Mplus.

A one-way analysis of variance (ANOVA) indicated that there was a significant effect of trajectory group on frequency of nicotine use Senior Year. The overall model was significant, $F(3, 1082) = 3.75, p = .011$). To determine which groups significantly differed, post hoc comparisons using the Tukey HSD test indicated that the mean score for the *Low/Minimal* group ($M=1.95, SD=1.72$) was significantly lower than those in the *Increasing* group ($M=2.49, SD=2.18, p=.006$). The *Low/Minimal* group did not significantly differ from either the *Decreasing* ($M=2.28, SD=2.04, p=.957$) or *Chronically Elevated* ($M=2.12, SD=1.91, p=.573$) groups, and no other significant group differences were identified. Similarly, a one-way ANOVA was calculated to determine if trajectory group influenced Senior year nicotine dependence. The overall model was significant, $F(3, 1397) = 3.92, p = .008$). Post hoc comparisons using the Tukey HSD revealed that the *Chronically Elevated* trajectory mean score ($M=1.52, SD=0.80$) was significantly higher than those in the

Low/Minimal group ($M=1.16$, $SD=0.04$, $p=.025$). The *Decreasing* and *Increasing* groups did not differ significantly from the other groups.

Regarding alcohol use, one-way ANOVAs for the effect of trajectory group on both alcohol use frequency, $F(3, 2203) = .94$, $p = .421$) and alcohol use quantity , $F(3, 2076) = .371$, $p = .774$) were not significant. Finally, the one-way ANOVA to determine is trajectory group influenced Senior year risky sexual behavior. The overall model was not significant, $F(3, 2268) = 1.48$, $p = .218$).

Table 11.

One-Way Analyses of Variance of Senior Year Health Behaviors by Trajectory Group

Source	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>P</i>
<i>Nicotine use frequency last 30 days</i>					
Between groups	3	39.10	13.03	3.75	.001*
Within groups	1082	3761.75	3.48		
Total	1085	3800.85			
<i>FTND score</i>					
Between groups	3	20.30	6.77	3.92	.008*
Within groups	1397	2413.92	1.73		
Total	1400	2434.22			
<i>Alcohol use frequency last 30 days</i>					
Between groups	3	2.72	.91	.94	.421
Within groups	2203	2130.32	.97		
Total	2206	2133.04			
<i>Alcohol use quantity</i>					
Between groups	3	1.02	.34	.37	.774
Within groups	2076	1897.83	.91		
Total	2079	1898.84			
<i>Risky sexual behaviors</i>					
Between groups	3	5.88	1.96	1.48	.218
Within groups	2268	2999.22	1.32		
Total	2271	3005.10			

Note. FTND= Fagerstrom Test of Nicotine Dependence, * $p<.01$

Discussion

Depression among college students has received increasing attention given this appears to be a vulnerable time for depressive symptoms and new onset of depressive disorders (Kessler et al., 2005; Gallagher, 2013). The larger developmental context, emerging adulthood, is associated with changing social support networks and increasing responsibilities (Arnett, 2000; 2007). Despite most individuals coping quite well with these changes, some individuals experience depression symptoms that, in turn, contribute to distress, poorer academic outcomes, and poorer social relationships (Gotlib, Lewinsohn, & Seeley, 1998; Vujeva & Fruman, 2011). Recently, researchers have explored trajectories of depression symptoms across emerging adulthood to disentangle factors that contribute to depression severity and pattern over time (Costello et al, 2005; Ferro & Liem, 2011; Yaroslavsky et al., 2013). Though the majority of individuals report low symptom levels throughout the transition to adulthood, some individuals appear vulnerable to more severe symptoms. The present study examines trajectories of depression severity across four years of college to better understand common patterns of depression severity over time, factors that affect initial level and change, and how trajectories are related to health behaviors at the end of college.

Overall, it appears that a single, average trajectory does not best describe depression symptoms among a specific group of emerging adults, college students. Instead, there are multiple trajectories of individuals with similar initial level and change over time in depression symptoms. Consistent with previous literature on trajectories of depression symptom severity in adolescence and emerging adulthood as in this sample (Costello et al., 2008; Frye & Liem, 2011; Stoolmiller et al., 2005; Wickrama & Wickrama, 2010;

Yaroslavsky et al., 2009), four patterns were identified. These included a group with low or minimal depression symptoms across the four years of college, a group with low initial symptoms that increased over time before leveling off, a group with initially high depression symptoms that diminished by Senior year, and a group with elevated symptoms Freshman year that persist through the Senior year. These are labelled as *Low/Minimal*, *Decreasing*, *Increasing*, and *Chronically Elevated*, respectively, for purposes of discussion. Additionally, some risk and protective factors predicted membership in various trajectories. Specifically, sex, sexual orientation, social support, and self-reported resilience were associated with likelihood of membership in specific trajectories.

Trajectories of Depressive Symptoms

The results of the present analyses provide support for four trajectories of depressive symptoms over the course of college. This is generally consistent with literature that has typically identified three to four distinct subgroups of individuals with similar trends in depression symptom severity over this time (Costello et al., 2008; Ferro et al., 2015b; Frye & Liem, 2011; Salmela-Aro et al., 2009; Stoolmiller et al., 2005; Wickrama & Wickrama, 2010; Yaroslavsky et al., 2014). Although data is mixed regarding the shape of these trajectories, likely due to methodological and assessment variations, two groups with relatively stable symptoms over time have been typically identified: a low or minimal symptom group and a group with persistently elevated depression symptoms (Costello et al., 2008; Ferro et al., 2015b; Frye & Liem, 2011; Yaroslavsky et al., 2014). The presence of both a *Low/Minimal* depression group and *Chronically Elevated* group fit with this existing literature suggesting two stable groups over the course of emerging adulthood.

Groups with varying severity over time, either increasing or decreasing across emerging adulthood, have also often identified (Costello et al., 2008; Frye & Liem, 2011; Salmela-Aro et al., 2008; Stoolmiller et al., 2005; Wickrama & Wickrama, 2010; and Yaroslavsky et al., 2014); however, previous studies, such as Frye & Liem (2011) have been limited to exploring only potential linear patterns. In contrast, the presence of five time points in the present analysis allowed for exploration of linear, quadratic, and cubic patterns over time. In considering model parameters and fit with theory, quadratic models were retained, and suggest a stabilization of symptoms by fourth year for both change groups. That is, within the *Increasing* group, symptoms appeared to stop increasing and level off, whereas individuals in the *Decreasing* experience declining symptoms across over the first three years of college, with similar levels of depression as those in the *Low/Minimal* group by Senior year.

A major difference with results from the current study is the proportion of the sample comprising each trajectory group. As in previous studies, the largest trajectory group was the *Low/Minimal* group (over 55% of the sample), suggesting generally good news that most college students consistently report low levels of depression symptoms. The proportion of the sample comprising this group was somewhat lower but generally consistent with other research identifying four trajectories, with a majority of the sample belonging to trajectories with minimal or low depression symptoms: 63% (Wickrama & Wickrama, 2010), 75% (Frye & Liem, 2011), and 88.1% (Costello et al., 2008). Of note, Costello and colleagues (2008) combined two groups, a no depressed mood trajectory (28.7%) and a stable low depressed mood (59.4%), suggesting both groups reported relatively low distress during the transition from adolescence to adulthood. The relatively lower proportion of the population in the

Low/Minimal group in this study may be due to specifics of the sample population, a highly diverse, urban campus with a high proportion of non-traditional students, as well as methodological differences (using the SCL-90, focusing specifically on college students, and including more frequent assessment). Within each trajectory group in this study, the variance of the intercept was also significant, suggesting there are individual differences in initial level over time. Although multiple trajectories improve on describing individuals compared to a single, average trajectory for the entire population, each trajectory does not perfectly describe all individuals within it (Bauer & Reyes, 2010).

More striking was the relative proportions of the sample within the depressed mood trajectories: *Decreasing* (2.8%), *Increasing* (11.6%), and *Chronically Elevated* (29.7%). Considering the two groups with changes in symptoms over time, the *Increasing* and *Decreasing* groups, smaller proportions of the sample compared to previous research have been found. Within other large, longitudinal samples, the proportions have been between 2.4% and 7% (Costello et al, 2008, Frye & Liem, 2011; Wickrama & Wickrama, 2009) for the groups with increasing symptoms over time, and 8% and 17% for a group with declining symptoms (Costello et al, 2008, Frye & Liem, 2011; Wickrama & Wickrama, 2009), though it should be noted that comparisons are imperfect given measurement and sample differences. Compared to these previous efforts, the current study offers additional insight specifically into how depression severity may fluctuate over the course of college in a highly diverse sample, and used GMM rather than LGCM methods to explore individual differences within trajectory groups.

Finally, nearly one-third of the sample comprised the *Chronically Elevated* group. The depression measure used in this study does not provide clinical cutoffs; however, this

likely represents a group of individuals with both subclinical and clinical depression symptoms as suggested by the average score and large variability, largest amongst the four trajectories. Depression symptoms are receiving growing attention on college campuses (Gallagher, 2013). Several reasons contribute to this: onset of depressive disorders frequently occurs at this age (Kessler, 2005 college students report a similar prevalence of psychiatric disorders as non-students (Blanco et al., 2008), and depression symptoms are associated with reduced academic attainment (Kessler et al, 1995; Hysenbegasi et al, 2005). This group may capture a subclinical/clinical group due to low variance from two sources: lower relative levels of depression compared to the general population and a limited measure of depression. The significant intercept variance in this group, highest among all four trajectories, may further support this as a “catch all” group of individuals with elevated, mild to severe, but persistent symptoms over time.

Previous research on depression trajectories has typically identified a much smaller proportion of individuals with stable high and/or clinical symptoms, ranging from 1% to 13% (Frye & Liem, 2011; Stoolmiller et al., 2005, Wickrama & Wickrama, 2010) in community-based and national representative samples and used longer measures of depression. Research suggests that prevalence of clinical depression is approximately 6% among adults (Kessler et al, 2006), and therefore these estimates are more in line with a smaller proportion of individuals experiencing persistent or elevated depression symptoms in college or emerging adulthood. At the same time, prevalence of depression may be higher among college students given unique academic and related stressors, with 16.8% of respondents for the National College Health Assessment reporting diagnosis and/or treatment for depression within the last twelve months (American College Health Association, 2017).

Predictors of Membership in Depressed Mood Trajectories

One of the major aims of this study was to identify factors that are associated with increased risk of belonging to one of the depressed mood trajectory groups: *Increasing*, *Decreasing*, or *Chronically Elevated*. Risk and protective factors were explored by way of comparing the odds of belonging to one of these depressed mood groups to belonging to *Low/Minimal* depression group.

Sex. Female sex has long been identified as a risk factor for experiencing depression at beginning in adolescence and continuing into adulthood (Kessler, McGonagle, Swartz, Blazer, & Nelson, 1993), and including the emerging adult period (Meadows et al., 2006; Adkins et al., 2009; Ferro et al., 2015b; Frye & Liem, 2011; Yaroslavsky et al., 2014; Rawana & Morgan, 2013). Consistent with this, females were more likely to belong to any of the depressed mood trajectories in this study. A particularly large effect was found for the *Chronically Elevated* group, such that women were almost twice as likely to belong to this group compared to males. Several hypotheses have been proposed for the effect of biological sex, including models that integrate affective, biological, and cognitive factors (Hyde, Mezulis, & Abramson 2008) and those that emphasize the effect of increased susceptibility to stress experiences and stress reactivity (Cyranowski, Frank, Young, & Shear, 2000, Nolen-Hoeksema, 2001). These results combined with previous research, suggests that women are likely to be particularly vulnerable to depression symptoms and for these to be persistent over the four years of college.

Race/Ethnicity. In contrast to previous research examining trajectories of depression (Adkins et al., 2009; Ferro et al., 2015b; Frye & Liem, 2011; Galambos et al., 2006; Meadows et al., 2006), race or ethnicity was not associated with increased likelihood of

belonging to a depressed mood group. Previous studies have suggested that persons identifying as a member of a diverse race or ethnicity group are at increased risk for depression due to increased experience of marginalization and greater exposure to stressful life events (Hatch & Dohrenwend, 2007; Williams, Neighbors, & Jackson, 2003), consistent with the Minority Stress Model (Meyer, 2003). However, no such effect was found within this study. Given the high level of diversity on the campus where this study was conducted, it seems possible that this effect may be less pronounced. In contrast, Adkins and colleagues (2009) found that increased risk was higher among persons from minority racial or ethnic backgrounds compared to White peers, with a stronger effect for Black and Latinx individuals compared to Asian individuals.

Sexual Orientation. Identification as gay, lesbian, or bisexual was associated with greater likelihood of membership in both the *Increasing* and *Chronically Elevated* trajectories. Although they compared average depression trajectory between heterosexual and lesbian, gay, and bisexual individuals across adolescence and into adulthood, Marshal and colleagues (2013) found that persons who identified as lesbian, gay, bisexual, or mostly heterosexual reported higher levels of depression symptoms and suicidality across the ages of 13-31 compared to heterosexual peers. A challenge in exploring sexual orientation and its relationship to depressed mood trajectories in this study is that college and emerging adulthood is a time of exploration and experimentation (Arnett, 2000; 2007), so although this suggests identification as lesbian, gay, or bisexual Freshman year was a risk factor, it may not fully capture those who chose not to answer or who later identify as non-heterosexual.

Stressful Live Events. Previous research has focused on exposure to stressful life events as a predictor of depression symptoms in emerging adulthood, including relating this

to depressed mood trajectories during this period (Meadows et al., 2006; Adkins et al., 2009). Although a significant effect was found, the relative increase in risk per exposure to stressful life events was low. In part, this may be due to the events captured by this measure, which focuses on acute events like losses, accidents, and legal issues; and does not capture a broader range of stressful events. Previous work suggests that persistent and chronic stressors, including low socioeconomic status, are associated with greater severity of depressive symptoms in emerging adulthood (Adkins et al., 2009; Pettit et al., 2010; Wickrama et al., 2008). It also reflects lifetime exposure and therefore does not capture short-term response to these stressors. Previous work has indicated that stressful events are associated with fluctuations over time, such that greater stress predicts higher depression scores the following year (Pettit et al., 2011).

Protective Factors. In addition to factors that may increase vulnerability to depression symptoms, factors that may serve a protective role were also explored. Higher perceived social support was associated with decreased likelihood of belonging to the *Decreasing, Increasing, or Chronically Elevated* trajectories. For every one unit increase on a measure of social support, the likelihood of belonging to the *Decreasing, Increasing, or Chronically Elevated* trajectories diminishes by 31%, 22%, and 37%, respectively. Perceived social support, specifically perceived parental support, is negatively associated with trajectories of depressive symptoms in emerging adults (Pettit et al., 2011), though the effect of parental support weakens over time, likely reflecting age-appropriate changes in support networks (Meadows et al., 2006; Pettit et al., 2011). On the other hand, depression often leads to social withdrawal and isolation, so this may be a reciprocal relationship. However, by measuring perceived social support during Freshman Fall semester, results of

this study suggested that connection with others and perception of having someone to rely on for support protects against depression during the rest of college, as measured by decreased likelihood of belonging to any depressed mood trajectory.

Similarly, self-reported resilience during Freshman Fall semester also appeared to decrease the likelihood of belonging to the depressed mood trajectories by between 25-50% per one-unit increase on this measure. Resilience has not been previously explored as a protective factor in depressed mood trajectories; although research about resilience in college student psychiatric symptoms has noted a positive effect, likely due to the relationship of perceived resilience to personality factors and coping styles that protect against poorer negative health outcomes (Campbell-Sills, Cohan, & Stein, 2006). Resilience has been shown to influence coping strategy selection, enhancing college students' abilities to persevere and bounce back despite stressors, thus reducing negative outcomes including those related to mental health (Hartley, 2011)

Health Behaviors and Depressed Mood Trajectories

Within the present study, comparison of trajectory groups in terms of health behaviors Senior year revealed an effect for nicotine use. Compared to the *Low/Minimal* trajectory group, persons in the *Increasing* and *Chronically Elevated* groups reported greater frequency of nicotine use and greater nicotine dependence, respectively. Alcohol use quantity and frequency and engagement in risky sexual behaviors did not appear to differ by group. Considering similar variables, Wickrama & Wickrama (2010) and colleagues reported depression trajectories are associated likelihood of engaging in risky lifestyle behaviors including smoking, drinking, and having multiple sexual partners. Specifically, they noted that, compared to persons in a low or minimal depression trajectory, individuals who were

characterized by a trajectory of increasing depression symptoms during emerging adulthood had the highest rates of these behaviors, and suggested that these may be unhealthy coping strategy for managing negative mood or be related to factors that increase depression indirectly, such as unhealthy peer influences. However, the results of the present study found only an effect for nicotine use and not the other health behaviors. Using only the Senior Year time point may not have adequately captured inconsistent usage. Additionally, depressed mood trajectory may not capture short-term efforts to cope with negative affect by engaging in risky health behaviors.

Strengths and Limitations

In terms of strengths, this study added to a growing literature on depressed mood trajectories in emerging adulthood using a large-scale longitudinal study with multiple waves and yearly follow-up. It also focused on a specific subgroup of emerging adults, college students, who have particular stressors and experiences that may affect depression vulnerability. Additionally, the study population was diverse, especially with regard to race and ethnicity, and included a large proportion of non-traditional students (e.g. parents, part-time, living off-campus, not entering directly from high school). Compared to previous studies examining trajectories of depression severity, this study focused more narrowly on college students and provided more frequent assessments. Finally, there was exploration of health behaviors related to depression symptoms over time, building on extant literature regarding negative outcomes of college student depression.

Several limitations should also be considered. First, this study represented a secondary data analysis, therefore the aims of this study were not considered in the initial design. Although the diverse sample allowed greater understanding of under-represented

groups' experiences, the results of this study may not generalize to other college campus or non-college attending students. Additionally, there was likely some self-selection effect given voluntary participation at each time point. Individuals, including those with severe depression that caused them to leave school or who otherwise did not continue to be enrolled, were not able to complete follow-up surveys. Second, the measure of depression, four items from the SCL-90 depression subscale, did not provide guidance for interpretation and this brief measure has limited variance for exploration. Also, depression symptoms measured approximately yearly would not capture more nuanced fluctuations or acute changes over time. Finally, use of Growth Mixture Modeling offers the ability to explore individual differences among groups with similar patterns of change over time; however, it also has its critics who note weaknesses including possibility of identifying spurious results (Bauer & Curran, 2003; 2004). Comparison with previous literature was also challenging given variation in analytic methods, specifically with regards to how variance between trajectory groups is considered within the model (i.e. differences between latent growth class analyses and growth mixture modeling).

Clinical Implications

Results from this study suggest that, although most college students report only minimal depression symptoms, elevated depression symptoms freshman year are more likely to remain high throughout college than to decline with time (less than 3% of the sample in this study followed this pattern). Thus, screening for depression symptoms and potential risk and protective factors during Freshman year may be helpful in early identification of students at risk for persistent symptoms, such as those both reporting emotional distress and an absence of protective factors. Assessing social support and resilience may further identify

students who could benefit from interventions to increase these modifiable factors. For example, brief behavioral activation has been shown to be effective in reducing depression symptoms among moderately depressed college students with promise in increasing social support (Gawrysiak, Nicholas, & Hopko, 2009). From a campus health perspective, it may be helpful to specifically target groups at risk for depression, including women and sexual minority individuals.

Pattern of depression symptoms over time may have clinical utility as well. Notably, persistent symptoms, whether mild or severe, are associated with greater distress, impairment, and likelihood of recurrence compared to acute and episodic forms of depression (Klein, 2008). In addition, onset of depressive symptoms, even if they remain subclinical, prior to age 21 is associated with more severe and recurrent symptoms than individuals with later symptom onset (Kovacs et al., 1984; Dekker et. al, 2007; Klein, 2008). Trajectories may also have value in predicting later outcomes. For instance, Chaiton et al. (2013) identified four adolescent trajectories of depression symptoms similar to those identified in this review. The trajectory groups were significantly and independently associated with mental health outcomes, including self-rated mental health, during young adulthood. Emerging adult depression trajectories may have similar value in predicting depression outcomes in later adulthood.

Future Directions

Future research should focus on examining depression symptoms in college students using a more comprehensive measure of depression that also provides information on distinguishing clinical from subclinical levels of symptoms, such as the empirically validated nine item Patient Health Questionnaire (Kroenke, Spitzer, & Williams, 2001). Additionally,

comparison with other campuses may clarify unique challenges for specific colleges from more generalized patterns for college student depression. Exploration of interventions, such as those to increase social support during college, and whether these can reduce depression symptoms among potentially vulnerable groups will also address the needs of this population. Finally, exploration of additional outcomes related to trajectories, both health and academic-related, may help to clarify the consequences of depressed mood trajectories over time.

Conclusions

Overall, this study added to a growing literature that suggests that there are varying patterns of depression symptoms over time, with a focus on college students. Although generally, depression symptoms can be described for emerging adults as increasing and then decreasing, this does not adequately describe all individuals in the population. Thus, disentangling groups with similar patterns in initial level and change over time is useful in identifying individuals vulnerable to depression during college, including women, those who identify as non-heterosexual, and those with low perceived social support and resilience.

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Appendix

Additional Analysis Results

Table A1.

Linear GMM 2-, 3-, 4-, and 5-Class Model Comparisons

Classes	AIC	BIC	VLMR	VLMR p-value	Entropy	Smallest Class ^a
2	136851.05	136937.32	1026.95	<.001	0.40	44.3%
3	136329.11	136444.13	529.94	<.001	0.46	19.0%
4	136180.22	136323.99	156.89	<.001	0.49	2.3%
5*	136033.33	136205.86	173.95	<.001	0.44	3.3%

*PSI warning

Note: Only the intercept was allowed to vary in these models. The slope variance was constrained at 0. Although models with freed intercept and slope were explored, these resulted in PSI warnings and thus not eligible for consideration.

Table A2.

4-Class Linear Model with Free Intercept

Class	Intercept M (SE)	Intercept Variance (SE)	Slope M (SE)	Proportion of sample (MLC)
1	6.98* (0.08)	0.85* (0.12)	0.10 (0.03)**	61.0%
2	8.89* (0.19)	2.89* (0.32)	1.95 (0.15)*	8.4%
3	11.92* (0.34)	8.06* (.28)	0.09 (0.12)	28.4%
4	14.03* (0.34)	2.59** (0.92)	-1.98 (0.16)**	22.2%

Note: M=mean, SE= Standard Error, MLC= most likely class

*p<.001, **p<.01

Figure A1.

Comparison of Values Predicted by 4-Class Linear GMM and Observed Means

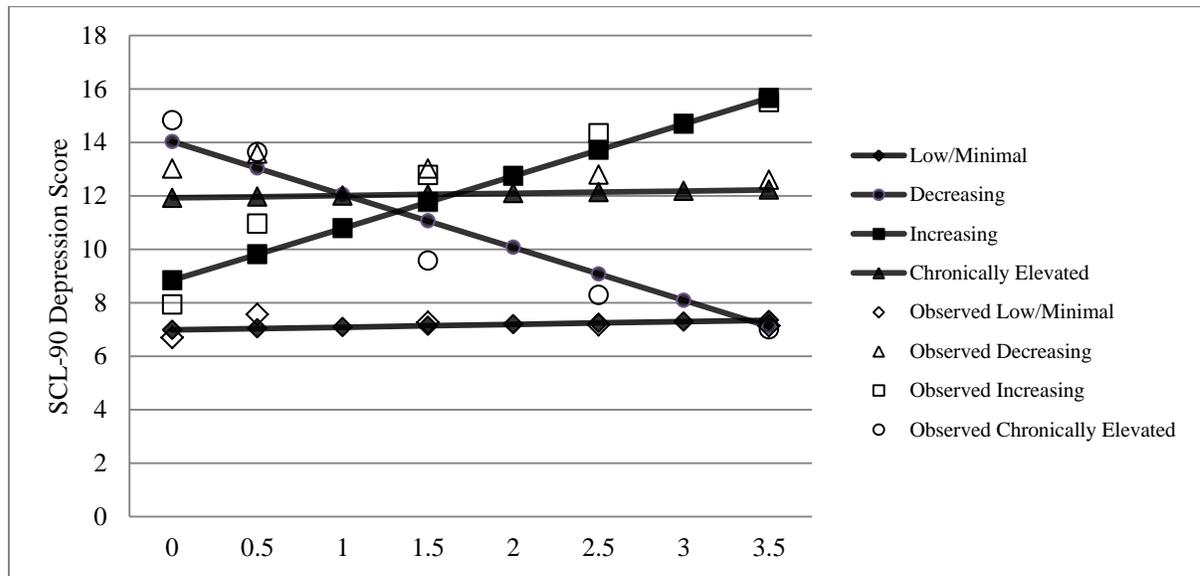


Table A3.

Cubic GMM 2-, 3-, 4-, and 5-Class Model Comparisons

Classes	AIC	BIC	VLMR	VLMR p-value	Entropy	Smallest Class ^a
2	136436.53	136551.54	1059.88	<.001	0.41	44.5%
3	135492.49	135650.64	956.04	<.001	0.51	21.9%
4	135196.27	135397.55	308.22	<.001	0.52	3.2%
5*,**	135005.31	135249.72	202.96	0.0013	0.54	3.4%

Note: Only the intercept was allowed to vary in these models. The slope, quadratic, and cubic parameter variances were all constrained at 0. Although models with freed intercept and slope were explored, these resulted in PSI warnings and thus not eligible for consideration.

*PSI warning, **Failed to converge

^aBased on most likely class

Table A4. Predictors of Group Membership: Chronically Elevated Group vs. Others

<i>Chronically Elevated vs. Other</i>						
Variable	<i>Low/Minimal vs. Chronically Elevated</i> <i>OR (95% CI)</i>	<i>p value</i>	<i>Decreasing vs. Chronically Elevated</i> <i>OR (95% CI)</i>	<i>p value</i>	<i>Increasing vs. Chronically Elevated</i> <i>OR (95% CI)</i>	<i>p value</i>
<i>Gender</i>						
Male	Reference		Reference		Reference	
Female	0.35 (0.20-0.62)	<.001	0.60 (0.27-1.35)	0.216	0.59 (0.31-1.12)	0.109
<i>Race/Ethnicity</i>						
White	Reference		Reference		Reference	
Minority/non-White	1.46 (0.90-2.38)	0.125	1.95 (0.94-4.02)	0.072	1.36 (0.31-1.12)	0.265
<i>Sexual Orientation</i>						
Heterosexual	Reference		Reference		Reference	
LGB	0.29 (0.16-0.50)	<.001	2.28 (0.86-6.10)	0.099	0.63 (0.79-2.33)	0.128
<i>LSE</i>	1.04 (1.01-1.07)	0.019	1.00 (0.97-1.04)	0.792	1.01 (0.98-1.04)	0.576
<i>Resilience</i>	1.78 (1.51-2.09)	<.001	0.89 (0.71-1.12)	0.328	1.34 (1.13-1.59)	0.001
<i>Social Support</i>	1.58 (1.42-1.75)	<.001	1.09 (0.94-1.27)	0.240	1.23 (1.10-1.37)	<.001

Note: LGB=Lesbian, Gay, or Bisexual; LSE= Lifetime stressful events

Table A5. Predictors of Group Membership: Decreasing Group vs. Others

<i>Decreasing vs. Other</i>						
Variable	<i>Low/Minimal vs. Decreasing</i> <i>OR (95% CI)</i>	<i>p value</i>	<i>Increasing vs. Chronically Elevated</i> <i>OR (95% CI)</i>	<i>p value</i>	<i>Decreasing vs. Chronically Elevated</i> <i>OR (95% CI)</i>	<i>p value</i>
<i>Gender</i>						
Male	Reference		Reference		Reference	
Female	0.59 (0.37-0.93)	0.025	0.99 (0.62-1.59)	0.964	1.67 (0.74-3.75)	0.216
<i>Race/Ethnicity</i>						
White	Reference		Reference		Reference	
Minority/non-White	0.75 (0.48-1.17)	0.208	0.70 (0.44-1.10)	0.124	0.51 (0.25-1.06)	0.072
<i>Sexual Orientation</i>						
Heterosexual	Reference		Reference		Reference	
LGB	0.65 (0.32-1.35)	0.249	1.43 (0.70-2.90)	0.322	0.44 (0.16-1.17)	0.099
<i>LSE</i>	1.04 (1.01-1.07)	0.003	1.00 (0.98-1.03)	0.784	1.00 (0.96-1.03)	0.792
<i>Resilience</i>	1.99 (1.70-2.33)	<.001	1.51 (1.29-1.75)	<.001	1.12 (0.89-1.42)	0.328
<i>Social Support</i>	1.44 (1.30-1.60)	<.001	1.13 (1.02-1.25)	0.024	0.91 (0.79-1.06)	0.248

Note: LGB=Lesbian, Gay, or Bisexual; LSE= Lifetime stressful events

Table A6.

Senior Year Health Behaviors by Trajectory Group and Total

	Low/Minimal <i>n</i> (%)	Increasing <i>n</i> (%)	Chronically elevated <i>n</i> (%)	Decreasing <i>n</i> (%)	Total <i>n</i> (%)
<i>Alcohol Use Senior Year</i>					
Frequency					
Never	68 (5.6%)	23 (3.9%)	23 (3.9%)	2 (2.5%)	115 (5.2%)
Monthly or less	331 (27.2%)	174 (29.4%)	174 (29.4%)	20 (25.3%)	622 (28.2%)
2-4 days/month	449 (37.0%)	203 (34.3%)	203 (34.3%)	33 (41.8%)	787 (35.7%)
2-3 days/week	313 (25.8%)	147 (24.9%)	147 (24.9%)	19 (24.1%)	560 (25.4%)
>3 days/week	54 (4.4%)	44 (7.4%)	44 (7.4%)	5 (6.3%)	234 (5.6%)
Typical Quantity					
1-2 drinks	445 (39.0%)	228 (40.2%)	228 (40.2%)	25 (32.5%)	800 (38.5%)
3-4 drinks	411 (36.0%)	209 (36.9%)	209 (36.9%)	37 (48.1%)	783 (37.6%)
5-6 drinks	200 (17.5%)	92 (16.2%)	92 (16.2%)	10 (13.0%)	349 (16.8%)
7-9 drinks	64 (5.6%)	31 (5.5%)	31 (5.5%)	5 (6.5%)	115 (5.5%)
10+ drinks	21 (1.8%)	7 (1.2%)	7 (1.2%)	0 (0.0%)	33 (1.6%)
<i>Nicotine Use Senior Year</i>					
Cigarette frequency (last 30 days)					
None	373 (65.1%)	185 (60.5%)	185 (60.5%)	23 (53.5%)	672 (61.9%)
1-2 days/month	83 (14.5%)	53 (17.5%)	53 (17.3%)	11 (25.6%)	171 (15.7%)
3-4 days/month	31 (5.4%)	20 (6.5%)	20 (6.5%)	1 (2.3%)	60 (5.5%)
5-11 days/month	26 (4.5%)	6 (2.0%)	6 (2.0%)	1 (2.3%)	14 (3.8%)
12-14 days/month	8 (1.4%)	5 (1.6%)	5 (1.6%)	1 (2.3%)	20 (1.8%)
15-25 days/month	20 (3.5%)	9 (2.9%)	9 (2.9%)	1 (2.3%)	35 (3.2%)
26-30 days/month	32 (5.6%)	28 (9.2%)	28 (9.2%)	5 (11.6%)	87 (8.0%)
	<i>M</i> (SD)	<i>M</i> (SD)	<i>M</i> (SD)	<i>M</i> (SD)	<i>M</i> (SD)
Nicotine dependence*	0.39 (1.16)	0.60 (1.37)	0.62 (1.52)	0.72 (1.60)	0.50 (1.32)
Risky sexual behavior	1.14 (1.18)	1.23 (1.29)	1.23 (1.20)	1.32 (1.62)	1.18 (1.22)
<i>Note:</i> These variables are only available for individuals within the first three waves and those who chose to complete the Senior Year Follow-up Survey.					

Vita

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