Bipolar Spectrum Risk and Social Network Dimensions in Emerging Adults: Two Social Sides?

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Abstract

Bipolar spectrum disorders (BSDs) encompass severe and chronic mood disorders associated with social functioning difficulties. However, little work has examined more nuanced aspects of social functioning in BSDs. The present investigation recruited 1,934 emerging adult college students to examine associations of self-reported bipolar spectrum risk (including both BSD risk and current mania and depressive mood symptoms) with social functioning with peers (including social network quantity and quality, social support, and social strain). Self-reported BSD risk was associated with greater social strain, but also greater social network quantity (or size) and social support. Post-hoc results suggest that self-reported mood symptoms were similarly associated with increased social conflict, but also greater social network quantity (or size) and social support. Taken together, these findings indicate a complex picture in which BSD risk and mood symptoms are associated with both social struggles as well as strengths. Implications for the involvement of social functioning in mood disturbance are discussed.

Keywords: bipolar spectrum disorders; mania; depression; mood disturbance; social functioning; social networks; emerging adulthood

Bipolar Spectrum Risk with Social Networks Dimensions in Emerging Adults: Two Social Sides of Bipolar Disorders?

Bipolar spectrum disorders (BSDs) are characterized by severe mood difficulties alternating between elevated (i.e., mania or hypomania) and often depressed or anhedonic mood phases (American Psychiatric Association [APA], 2022). BSDs occur in approximately 2.4% of adults globally and incur significant functional costs, high suicide rates, and are among the leading causes of disability worldwide (e.g., Merikangas et al., 2011). Individuals with BSDs are at elevated risk for comorbid psychological disorders and substance use (Sagman & Tohen, 2012), suicidality (Merikangas, et al., 2011) and increased mortality (Lomholt et al., 2019). Further, the economic cost of BSDs is in the billions in the U.S. and millions in the UK annually (Cloutier et al., 2015; Young et al., 2011). This underscores the personal and global burden of BSDs.

A key psychosocial process implicated in BSDs is social functioning. For example, people with BSDs have been found to have more social skills deficits, worse intimate partner and peer relationships, and difficulty understanding the emotions of others (Devlin et al., 2016; Goldstein et al., 2006; Rocca, et al., 2008; Romans & McPhearson, 1992). This is compounded by the fact that the modal age at onset of BSDs overlaps with emerging adulthood (18-25) (Kessler et al., 2007; Leboyer et al., 2005). Importantly, emerging adulthood is a developmental period typically marked by social network expansion and development of supportive social relationships (Arnett, 2000; Baldessarini et al., 2012). This underscores the importance of examining social networks during a peak window of BSD vulnerability in emerging adulthood. Specifically, examining the quantity and quality of social network relationships provides a

window into understanding peer relationships which have been shown to predict optimized mental health and mood functioning.

The present study thus aims to enhance our understanding of important psychosocial outcomes in BSDs by examining social networks and self-reported trait BSD risk and mood symptom severity during emerging adulthood. Specifically, we aim to understand social networks by concurrently examining both positive and negative dimensions of peer relationships; by investigating social network quantity and quality (i.e., number of friends one shares emotional information with) of peer relationships and social support and strain (i.e., conflict within peer relationships), and self-reported trait mood disorder risk and mood symptom severity in emerging adults.

Bipolar Disorder and Social Functioning

BSDs are marked by increased energy and activity, often of a social nature, including more frequent social interactions (APA, 2022). BSDs often involve periods of depressed mood as well, often characterized by associated symptoms of social withdrawal. Emerging adulthood is a key developmental lifespan period to study BSDs, given emerging adults also are more likely to engage in a variety of socially risky behaviors with peers, including promiscuous sexual activity, alcohol and substance use, binge drinking, and risky and drunk driving (Arnett, 2000). In a college-aged sample, Holt et al. (2018) found a significant association between peer relationships and overall social functioning and increased peer-connections were associated with less loneliness and increased feelings of security within their social networks. Positive peer friendships also predict overall adjustment during emerging adulthood (e.g., O'Connor et al., 2011). However, few studies to date have concurrently examined both adaptive and maladaptive facets of social functioning in BSDs.

Social Struggles in BSDs. Several lines of evidence confirm that BSDs are associated with serious and often maladaptive social functioning. First, diagnostic criteria for mania involves excessive social activity, including haphazard enthusiasm for interpersonal interactions (e.g., garrulous conversations with strangers), intrusive talkativeness (e.g., not letting anyone else get a word in edgewise), and increased sociability that may be unreciprocated or inappropriate (e.g., calling old acquaintances or strangers out of the blue) (APA, 2022). Criteria for depression, a common part of BSDs, include diminished social interest and increased social withdrawal during periods of sad or low mood. Second, even during periods of euthymia (i.e., not currently manic or depressed), individuals with BSDs exhibit marked social deficits. Specifically, Goldstein et al. (2006) found that euthymic adolescents with BSDs had worse social skills performance (i.e., less appropriate use of social skills, more recalcitrant behaviors) as rated by the individual themselves and their parents, compared to healthy control participants. Rocca and colleagues (2008) found that euthymic adults with bipolar disorder type I (the most severe form of BSDs) displayed poorer conversational skills and social openness (i.e., willingness to engage in social interactions with unfamiliar others) compared to healthy controls. Third, Romans and McPhearson (1992) found that euthymic individuals diagnosed with bipolar disorder type I reported fewer close relationships as compared to a random community sample of women who were not excluded for meeting diagnostic criteria for another psychiatric disorder (besides bipolar disorder). The same study also found that BSD individuals self-reported having fewer close friends, lower quality of attachment and availability (e.g., count of the number of social interactions one participated in), and lower quality of social integration compared to the same community sample group described above. Finally, adults with a clinically diagnosed history of mania scored lower than non-psychiatric control participants on total overall social functioning

as assessed by self-reported number of friends and engagement in prosocial activities (Hellvin et al., 2013). Finally, Cannon et al. (1997) found that individuals diagnosed with bipolar disorder type I were significantly more likely to score in the worst quartile of the distribution for overall social adjustment, measured as sociability, peer relations, academic outcomes, and interests, compared to a group of non-psychiatric controls. Taken together, this work underscores the prominent role of social difficulties in BSDs and the need for greater research into social processes during periods of peak mood risk.

Social Strengths in BSDs. A parallel line of research suggests that BSDs also may be associated with social strengths; that is, putatively adaptive or prosocial social processes. Such findings are consistent with more general accounts of BSDs as containing "two sides" of concurrently adaptive and maladaptive psychosocial qualities (e.g., Galvez et al.; 2011; Lobban et al., 2012). Several lines of direct and indirect evidence support this complementary but distinct perspective. First, during periods of mania, adults with BSDs are characterized by increased charisma and social activity (Goodwin & Jamison, 2007). Second, Sato et al. (2003) found that BSD diagnosed adults report a greater quantity of social contacts in general, compared to participants with a clinical diagnosis of unipolar depression (Sato et al., 2003). Third, scales assessing BSD relevant traits, such as the Hypomanic Personality Scale (Eckblad & Chapman, 1986), include positive social functioning such as increased social confidence, perceived leadership, and social charisma. Fourth, the quality of interpersonal relationships is greater among people with BSDs, including drive to share positive emotions and self-reported better understanding, empathy, and sympathy towards others (Lobban et al., 2012). Fifth, other work suggests that adults with a history of bipolar disorder type I cooperated more on standardized behavioral economics tasks compared with a non-psychiatric control group (Ong et al., 2017).

Sixth, Morriss et al. (2007) found that people diagnosed with BD currently experiencing manic or depressive mood symptoms had worsened social adjustment and more friction in relationships; however, those with lower-level hypomanic symptoms indicated more social activity and better adjustment. Finally, one meta-analysis across 81 studies reported that BSDs were associated with positive psychosocial outcomes including empathy (Galvez et al., 2011). However, relatively few studies have investigated social functioning in BSD-relevant samples using concurrent measures of social struggles (i.e., maladaptive processes) and social strengths (i.e., adaptive processes).

The Present Investigation

The present investigation examined associations between self-reported BSD risk and different aspects of social networks, including the quantity and quality of peer friendships and perceived social support and strain in emerging adults. We recruited emerging adult college students between the ages of 18-25 across five demographically diverse university sites to examine cross-sectional associations between validated measures of self-reported BSD risk and self-reported current mood symptom dimensions with social strengths and impairments. We sought to address three main gaps in the literature. First, we are aware of no work that has directly examined the link between BSD risk and putatively adaptive and maladaptive social functioning processes concurrently during emerging adulthood. Second, no work to date has used innovative and well-validated social network measures in BSD-relevant samples, which is critical to uncover broader aspects of social functioning contexts. Third, few studies have examined these issues in emerging adults, who are at peak risk of BSD onset and severity when formation of healthy social relationships is critical. Using a large multi-site approach across five universities, we centered on two interrelated aims:

Aim 1: Associations Between BSD Risk and Social Struggles. The first aim examined associations between a validated measure of self-reported BSD risk and social network quality. According to a s*ocial struggles perspective*, self-reported BSD risk should be associated with negative aspects of social network quality (**Aim 1a**) and increased self-reported social strain (**Aim 1b**). Importantly, these findings should hold controlling for current self-reported mood symptom severity to establish the trait-like nature of these associations with self-reported BSD risk. This perspective is supported by literature documenting worsened perceived quality of attachment and overall social functioning compared to non-clinical controls (Goldstein et al., 2006). We note that these analyses will allow for the secondary examination of associations between BSD-relevant mood symptoms (mania, depression) and the same dimensions.

Aim 2: Associations Between BSD Risk and Social Strengths. The second aim examined associations between a validated measure of self-reported BSD risk and positive social processes including greater social network size (i.e., number of friends identified in their peer-social network) and perceived social support. According to a non-mutually exclusive *social strengths perspective*, self-reported BSD risk should be associated with an increased social network size or quantity as measured by total number of friends reported (**Aim 2a**) and increased self-reported social support (**Aim 2b**), which should hold controlling for current self-reported mood symptom severity. This perspective is grounded in literature documenting increased social activity, number of social contacts, and cooperative behaviors among BSD-relevant samples (Goodwin & Jamison, 2007; Ong et al., 2017; Sato et al., 2003). We note that these analyses will allow for the secondary examination of associations between BSD-relevant mood symptoms (mania, depression) and the same dimensions.

Methods

Participants

Participants were 1,934 emerging adults recruited as part of a larger multi-site study on mental health in emerging adulthood (for description of the initial project from this larger dataset see: https://osf.io/mwdkf). Participants were college students recruited from one of five geographically and demographically distinct universities including the University of Colorado Boulder, USA (*n*=679; IRB #18-0483), University of California Berkeley, USA (*n*=836; IRB # #2019-05-12210), University of British Columbia, Vancouver Canada (*n*=197; BREB #H19-01559), University of California, Irvine, USA (*n*=117; HS# 2019-5354) and the University College London, United Kingdom (*n*=105; IRB #12673/001). Participants were recruited using posted flyers around campus, online advertisements (e.g., campus website forums), and list-serv announcements during 2019-2020 Academic Year (prior to the 2020 COVID-19 pandemic outbreak). Inclusion criteria included being a self-reported college student, fluent in English, and between 18-25 years old. Participant characteristics are in **Table 1**. Participants that failed > 1 attention check items (*n*=110) or did not complete the primary BSD or social network measures (*n*=339) were excluded.

Survey Measures

See **Table 2** for descriptives for all measures. We note that the survey questionnaires described below were embedded in a broader study protocol (see **Supplementary Materials** for list of full survey measures).

Bipolar Spectrum Disorder (BSD) Risk. Self-reported trait BSD risk was measured using the short form of the self-reported Hypomanic Personality Scale (HPS-20; Mead & Bentall, 2008), a 20-item self-report measure derived from the original 48-item HPS scale (Eckblad and Chapman, 1986) with comparable psychometric properties as the original scale

(Sperry et al., 2015). Individual items on the HPS-20 are rated true or false with higher scores reflecting increased risk for hypomania/mania (i.e., the core diagnostic component of BSDs). Items assess relevant BSD domains including elevated mood (e.g., "*I often feel excited and happy for no apparent reason*"), increased self-esteem (e.g., "*I seem to have an uncommon ability to persuade and inspire others*"), and hyperactivity (e.g., "*There are times when I am so restless that it is impossible for me to sit still*"). Previous work has demonstrated that the HPS is a strong and robust predictor of BSD onset (Kwapil et al., 2000; Walsh et al., 2015). Internal consistency across all participants was good in the present study (α=0.77).

Current Mood Symptoms. Consistent with past work using the HPS, self-reported current mood symptoms were used as covariates to ensure that observed associations between self-reported BSD trait risk and social processes were robust when accounting for current symptoms (e.g., Gruber et al., 2005; Johnson, 2005). However, we also report analyses of associations between self-reported current symptoms and social network processes. Current mood symptoms of mania and depression, both part of the core symptoms for BSDs, were assessed using the DSM-5 Cross Cutting Symptom Measure which is a 23-item self-report measure with items rated on a 0 (*none, not at all*) to 4 (*severe, nearly every day*) scale, with higher scores indicating more severe symptoms. The scale includes 13 distinct psychiatric dimensions drawn from the Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (APA 2013; APA, 2022). The present investigation focused specifically on the depression symptom domain (i.e., DSM5-Dep) measured using two items assessing sad mood ("*feeling down, depressed or hopeless*") and anhedonia ("*little interest or pleasure in doing things*") and the mania symptom domain (i.e., DSM5-Mania) using two items assessing hyperactivity ("*starting lots more projects than usual or doing more risky things than usual*") and reduced

need for sleep ("*sleeping less than usual, but still have a lot of energy*"). Consistent with scale scoring recommendations, the highest (or maximum) score endorsed from each subscale was used to measure self-reported current depression or mania severity, respectively.

Also consistent with scoring recommendations, the Altman Self-Rating Mania (ASRM) scale (Altman et al., 1997) was used to supplement the DSM5-Mania items for additional continuous mania severity information. The ASRM is a 5-item self-report measure rated using a 0 (e.g., not at all) to 4 (e.g., present to an extreme degree) scale. Individual responses were summed to create an overall score and higher scores indicated greater mania severity, with more stringent cutoff scores ≥ 14 indicating probable clinically significant mania symptoms (e.g., Gruber et al., 2008), though we note that other researchers have used lower cutoff scores ≥ 6 to indicating probable clinically significant mania symptoms (Altman et al., 1997). We refer to this as our measure of elevated mood, to differentiate from our measure of acute symptoms of mania. Internal consistency for the ASRM was good in the present study (α=0.73).

Social Network Dimensions

To achieve a more comprehensive assessment of adaptive and maladaptive facets of social functioning, we measured several distinct domains of social network processes. This included validated social network measures assessing the size (or quantity) and quality of peer social networks as well as perceived characteristics of social networks including self-reported social support and strain with peers. Social network quantity and quality were measured within participants' peer student cohorts, consistent with previous studies using the same measures (e.g., Morelli et al., 2017; Parkinson et al., 2018; see **Supplementary Materials** for item text).

Social Network Quantity and Quality. To assess social network quantity among college peers, we used items from Parkinson et al. (2018) modified for first-year college students. We

assessed both the quantity (i.e., size) and quality of social networks of participant's peer friendships at college. The total number of unique individuals listed by the participant was summed to form a total Social Network Scale (SN) Quantity score. We followed previously validated procedures utilized in other social network research among college students (i.e., Morelli et al., 2017) to specifically query the quantity and quality of college student peers. To assess social network quality, we used two items adapted from Morelli et al. (2017) asking who they share good news with (i.e., SN-Quality Good News) and who they turn to when something bad happens (i.e., SN-Quality Bad News). The total number of individuals listed was summed for the SN-Quality Good News and SN-Quality Bad News items, which were strongly correlated with each other (r=.75, p <.001). Hence, these scores were averaged across both items to create an overall SN-Quality score. If only one item was endorsed then the mean was not computed, which excluded n=29 participants.

Social Support and Strain. Social support and strain were measured using an adapted version of previously validated measures (Schuster et al., 1990; Whalen & Lachman, 2000). This included four items measuring social support (e.g., "*How much do your friends really care about you?*") and four items measuring social strain (e.g., "*How often do they let you down when you are counting on them?*"). All items were rated from 1 (a lot/often) to 4 (not at all/never). Items were summed separately to create a social support and social strain subscales, and subscales were then reverse coded so that *higher* scores represent *more* social support or social strain, respectively. Both social support and social strain subscales had strong internal reliability (α=0.85 and 0.75, respectively).

Procedure

The study procedure consisted of three parts. First, interested participants contacted the laboratory and were assigned an anonymous identification number to complete the online study survey. Second, participants completed online surveys via Qualtrics lasting approximately 60-75 minutes, which included the HPS-20, DSM-5 (mania and depression items), ASRM, SN-Quantity, SN-Quality, and Social Support and Strain scales, as well as others not part of the present investigation (see **Supplementary Materials**). Third, surveys were reviewed offline for completeness and attention check items and participants who successfully completed the survey were compensated via cash, Amazon gift card, or the SONA Psychology subject pool if available for interested participants at their respective university site.

Results

Preliminary Analyses

We conducted several initial preliminary analyses. First, we examined the data for potential outliers following recommended guidelines (e.g., Howell, 2008, p. 341-357; Blaine, 2018). Specifically, data +/-3 standard deviations from the mean were Winsorized (i.e., adjusted to the next highest or lowest score on the same scale that was not an outlier) which resulted in < 1.8% of the total participant sample being Winsorized (i.e., *n*=1 participant for the SN-Quality and *n*=33 participants for the SN-Quantity variable). Second, we examined the distributions of our eight main study variables (i.e., HPS-20, DSM5-Mania, DSM5-Depression, ASRM, SN-Quantity, SN-Quality, Social Strain, and Social Support) which can be found in **Table 2**. Following previous guidelines for data distribution cutoffs (i.e., skewness indices of +/-2 and kurtosis indices of +/-7 for large samples; i.e., Kim, 2013), none of the variables were outside of normal limits. However, when we adopted more stringent cutoff recommendations (e.g., skew +/-1; kurtosis of +/-1; Hair et al., 2022), we note that SN-Quantity (skewness statistic= 1.319;

kurtosis statistic=1.854) and DSM5-Mania (kurtosis statistic = -1.075) were outside of normal limits. However, given the large sample size, it is unlikely that these levels of skew and kurtosis are severe enough to impact interpretations of results. Third, we conducted bivariate correlations among all our main study variables. As seen in **Table 3**, the primary study measures were correlated in the expected directions.

Data Analysis Plan and Main Analyses

Aim 1: Associations Between BSD Risk and Social Struggles. The first aim examined a *social struggles perspective* on BSD Risk, suggesting that self-reported trait BSD risk would be associated with lower quality of peer-social networks as measured by a lower number of friends one shares emotional information with (*Aim 1a*) and increased self-reported social strain (*Aim 1b*). A hierarchical linear regression analysis was used to investigate associations between self-reported trait BSD risk and self-reported social network quality and social strain. We ran two separate regression analyses for each of our outcome measures (i.e., SN-Quality and Social Strain). We first entered demographic covariates (Age, Binary Sex) in Block 1, current self-reported symptoms (DSM5-Depression, DSM5-Mania, and ASRM) in Block 2, and self-reported trait BSD Risk (HPS-20) in Block 3. In these analyses, missing data were deleted listwise and multicollinearity diagnostics indicated acceptable tolerance (0.83) and VIF statistics (< 2.0), and Cook's distance did not indicate any significant outlier cases (e.g., Cook's distance values all < .05).

For Aim 1a**,** results for Block 1 showed that age and sex were not significantly associated with SN-Quality (Model 1: $F(2, 1091)=.53$, $p=.558$). For Block 2, there was a significant association of current self-reported mood symptoms with SN-Quality (Model 2: $F(2, 1088)=14.13$, $p < .001$). As seen in **Table 4**, examining individual beta values suggested that

current self-reported depression symptoms (DSM5-Dep) were associated with lower SN-Quality and current self-reported elevated mood symptoms (ASRM) were associated with higher SN-Quality. When self-reported trait BSD risk (HPS-20) was entered in Block 3, the overall model was not significant but trending for BSD risk being associated with higher SN-Quality scores (Model 3: $F(1, 1087)=3.71$, $p=.054$). In summary, current self-reported depressive symptoms were associated with lower SN-Quality, current self-reported manic symptoms were associated with higher SN-Quality, and BSD risk had a trending but non-significant association with higher SN-Quality.

For Aim 1b, results for Block 1 indicated that age and sex were significantly associated with Social Strain (Model 1: $F(2, 1911)=21.42$, $p < .001$). As seen in **Table 4**, higher age was associated with lower social strain and self-identified males endorsed greater social strain in their relationships than self-identified females. For Block 2, there was a significant association between current self-reported mood symptoms and social strain (Model 2: $F(3, 1908)=45.79$, $p < .001$). As seen in **Table 4**, individual beta values suggest that current self-reported depression symptoms (DSM5-Dep) and current self-reported mania symptoms (DSM5-Mania) were associated with higher Social Strain. By contrast, our other measure of elevated mood (ASRM) was associated with lower Social Strain. When self-reported trait BSD Risk was added to the overall model the relationship was significant and BSD risk was associated with greater Social Strain (Model 3: $F(1, 1907)=40.77$, $p < .001$). In summary, both current self-reported mood symptoms and self-reported trait BSD risk were associated with higher Social Strain.

Aim 2: Associations Between BSD Risk and Social Strengths. The second aim examined a *social strengths perspective* on BSD risk, suggesting that self-reported trait BSD risk would be associated with a greater social network size or quantity as measured by total number

of overall friends reported (*Aim 2a*) and greater self-reported social support (*Aim 2b*). Consistent with Aim 1, Aim 2 used a hierarchical linear regression to investigate associations between self-reported trait BSD risk and self-reported social network quantity and social support. We ran two separate regression analyses for each of our social functioning measures (i.e., SN-Quantity and Social Support). We entered demographic covariates (Age and Binary Sex) in Block 1, current self-reported mood symptoms (DSM5-Depression, DSM5-Mania, and ASRM) in Block 2, and self-reported trait BSD Risk (HPS-20) in Block 3). Missing data were deleted listwise and multicollinearity diagnostics indicated acceptable tolerance (0.83) and VIF (< 2.0) statistics, and there was no indication of any significant outliers (i.e., Cook's distance values all ≤ 0.31).

For Aim 2a, results for Block 1 showed that there was no significant relationship between age and sex and SN-Quantity (Model 1: $F(2, 1884)=0.16$, $p=.855$). For Block 2 there was a significant association between current self-reported mood symptoms and SN-Quantity (Model 2: $F(3, 1881)=14.09$, $p < .001$). As seen in **Table 4**, individual beta values indicate that current self-reported depression symptoms (DSM5-Dep) were associated with lower SN-Quantity, but self-reported mania symptoms (DSM5-Mania) were not significantly associated with SN-Quantity. Of note, our additional continuous measure of elevated mood (ASRM) was associated with higher SN-Quantity. When self-reported trait BSD risk was added to the overall model in Block 3, the relationship was significant suggesting that self-reported trait BSD risk was associated with higher SN-Quantity (Model 3: $F(1, 1880)=5.24$, $p=.022$). Taken together, self-reported trait BSD risk and current self-reported mania symptoms were associated with higher SN-Quantity, whereas current depression was associated with lower SN-Quantity.

For Aim 2b, results from Block 1 showed a significant association of age and sex and social support (Model 1: $F(2, 1911)=6.51$, $p=.002$). Specifically, as seen in **Table 4** self-

identifying males reported lower support on average than self-identifying females, while age had no effect. For Block 2, there was a significant relationship between current self-reported mood symptoms and social support (Model 2: $F(3, 1908)=77.16$, $p < .001$). **Table 4** shows individual beta values indicating that current self-reported depression (DSM5-Dep) and self-reported mania (DSM5-Mania) symptoms were associated with lower social support. Our additional measure of elevated mood (ASRM) was associated with higher social support. When self-reported trait BSD risk was added to the model in Block 3, results were significant suggesting that self-reported trait BSD risk was associated with greater social support (Model 3: $F(1, 1907)=4.43$, $p=.035$). In summary, self-reported trait BSD risk was linked to higher social support and current self-reported depression and mania symptoms were associated with lower social support.

Discussion

BSDs are serious psychiatric disorders that have severe impacts on afflicted individuals' personal, social, and economic well-being. Those with BSDs have higher rates of mortality and suicide attempts and suffer serious financial burdens (i.e., Cloutier et al., 2015; Merikangas et al., 2011; Young et al., 2011). Furthermore, college students, and emerging adults, are at heightened risk for mood disorder development, making them a relevant population for investigating bipolar risk and social outcomes (Arnett, 2000). BSDs have been linked to a variety of social outcomes. Primarily, bipolar disorder research has focused on links to negative social outcomes like impairment (i.e., Rocca et al., 2008). Yet, an emerging body of literature has begun to suggest that BSDs also might be associated with concurrent social strengths (Galvez et al., 2011; Ong et al., 2017). Given the important role of social processes in psychological well-being during emerging adulthood when individuals are also at a peak window of vulnerability for mood disturbance risk, the present investigation sought to examine both the social strengths and

impairments of social network processes in association with self-reported trait risk for bipolar spectrum disorders (BSDs) using a large cross-sectional sample of emerging adults enrolled at five geographically and demographically distinct, though primarily English-speaking, universities in North America and the United Kingdom.

Aim 1: Associations Between BSD Risk and Social Struggles

The first aim sought to investigate whether maladaptive social outcomes are heightened in groups at risk of developing BSDs. Specifically, we hypothesized that the quality of social network relationships would be lower and that perceived social strain would be higher in students with greater self-reported trait BSD risk. These hypotheses were partially supported by the results suggesting that perceived social strain was robustly associated with increased self-reported trait BSD risk; however, there was no relationship between social network quality and BSD risk. These findings are convergent with past literature on BSDs and impaired social outcomes, including social deficits (Goldstein et al., 2006) and worsened overall social functioning compared to the general population (Hellvin et al., 2013). Specifically, our results indicating that greater social strain is associated with greater self-reported trait BSD risk converge with findings such as those of Schudlich et al. (2008), who found that those with BSDs in both parents and children had greater social conflict in the family unit. Other studies (e.g., Greenberg et al., 2014; Robb et al., 1997) also describe associations between BSDs and impaired social functioning outcomes, and highlight links between BSDs and poorer overall well-being, more tumultuous close relationships, and less social support across mood phases of the disorder.

Our findings may be explained by literature such as that of Weintraub et al. (2022), who found that adolescents at high-risk of developing BSDs had significant social impairment – but only during periods of depressive mood. During depression, high BSD risk individuals displayed

more social withdrawal and physical and relational aggression – but self-reported mania symptoms were not associated with any social impairment outcomes. This fits into the present investigation's findings in that BSD risk is associated with negative social consequences; however, this may be more of a function of mood symptoms that are common in BSDs like depression, whereas mania symptoms are not necessarily associated with maladaptive social outcomes.

Taken together, our findings contribute to a robust literature on the social costs of BSDs. They further extend the literature by reinforcing these findings using innovative social network measures among a large and diverse sample of emerging adults. These findings support the relevance of empirically supported treatments for BSD risk that include a central focus on social processes, including clinical interventions like Interpersonal and Social Rhythm Therapy (Frank et al., 2019), and Dialectical Behavioral Therapy that promotes skills to target interpersonal relationship strain (Eisner et al., 2017). Future work should further examine the unique social challenges associated with peer relationships during emerging adulthood as an avenue for empirical study and targeted intervention efforts.

Aim 2: Associations Between BSD Risk and Social Strengths

The second aim investigated if there may be potentially adaptive or prosocial outcomes associated with heightened vulnerability to BSDs. We hypothesized that social network quantity and social support would be associated with increased self-reported trait BSD risk scores. Both hypotheses were supported, as self-reported trait BSD risk was associated with a greater quantity of student peers reported and perceived social support from their peers. The present investigation's findings that self-reported trait BSD risk was associated with more prosocial or socially adaptive outcomes is consistent with a small but growing literature on social strengths in

BSDs. This includes literature suggesting BSD risk and diagnosis are associated with increased positive social outcomes including cooperation (Ong et al., 2013) and social outgoingness and number of social contacts (Sato et al., 2003). Other congruent lines of literature emphasize increased positive social characteristics, such as social confidence, leadership, and charisma, associated with BSDs (e.g., Goodwin & Jamison, 2007). Some qualitative studies with BSD samples also have identified common themes related to positive social outcomes, including feelings of better ability to empathize with others, social advantage (e.g., more outgoingness), and more connection with close others (e.g., Lobban et al., 2012; Owen et al., 2017). Although we found associations between self-reported trait BSD risk and a greater number of friends and social support, these results contrast with much of the past literature that highlights worsened social functioning as a result of BSDs. A possible explanation for these contrasting results may lie in the distinction between differing severity levels within BSDs. In a non-clinically diagnosed sample, such as in the present study, social consequences might in fact be more prosocial or adaptive – given that hypomania (a milder form of mania) may be associated with links to increased charisma and outgoingness, but may not reach levels of severity to the point in which social outcomes are negatively affected. Additional work to unpack the contexts and clinical presentations in which adaptive social functioning occurs in BSDs is warranted.

Importantly, some studies have linked positive relationship outcomes with better prognosis in bipolar disorder, underscoring the clinical utility of understanding predictors of adaptive social functioning in BSDs. For example, Johnson et al. (1999) found that greater social support in individuals diagnosed with bipolar disorder is linked with better prognosis and fewer depressive mood episodes, thereby buffering some of the most frequently impairing symptoms associated with BSDs. In a similar vein, Cohen et al. (2004) found that more social support was

associated with fewer mood episodes and less hospitalizations in patients diagnosed with bipolar disorder type I. Finally, a meta-analysis of the positive effects of social support on BSD outcomes highlighted links between more positive social relationships and adherence to medication and treatment plans, fewer mood symptoms (mania and depression), and full-symptom remission (Studart et al., 2015). These studies emphasize the tangible importance of positive social relationship networks and support for the course of BSDs.

Finally, across both study aims, we note surprising and unique effects observed specifically for one of our continuous mania rating scales (i.e., the ASRM). Results indicated significant findings in somewhat opposite directions for the ASRM compared to our DSM5-Mania scale that specifically measured difficulties as a result of mania symptoms. We note that the mean of our ASRM measure of self-reported elevated mood was below more stringent clinical cutoffs (e.g., Gruber et al., 2008), though we note it was well within the range of lower and common symptom cutoffs (Altman, 1997). Nonetheless, it may be the case that the ASRM is of limited clinical utility when examining non-clinical populations and may be picking up more general elevated or positive mood, rather than clinically significant manic symptoms. Therefore, caution should be exercised when drawing interpretations from this measure.

Limitations and Future Directions

We highlight several key limitations to contextualize the current findings. First, the current study relied entirely on self-report data administered remotely via a survey-based platform. Although this study marked an important first step towards examining social network dimensions and mood risk in young adults in a larger sample, self-report data raises concerns regarding standardization of procedures and self-report bias. Future studies should adopt multi-method approaches that integrate behavioral (i.e., dyadic interactions, ambulatory sampling of

social interactions) and more in-depth structured clinical interview methodologies. Such measures may help unpack different domains and aspects of social network functioning in BSDs and compare that to perceived social outcomes.

Second, we note that this was one of the first studies to utilize previously validated measures of social network domains (Morelli et al., 2017; Parkinson et al., 2018) in bipolar disorder research. Our original rationale for limiting reported friendships to only same college-year student peers in the present study was two-fold. First, this approach was consistent with study procedures utilized in other social network research examining emerging adult peer relationships (i.e., Morelli et al., 2017). Second, by specifically asking participants to report on quantity and quality of same college-year peers we were able to limit the number of participants reporting on more possibly non-peer relationships, including family members and non-college peers. Although this marks an important first-step in assessing social network dimensions in bipolar disorders, such measures were constrained to assess a narrower facet of social networks among college peers, which may have limited its generalizability. Indeed, the social network measures used in the present investigation may have been constrained in their ability to examine more nuanced facets of dynamic social connections during emerging adulthood. Future studies on social networks and mood risk dimensions can expand upon this work in several ways. For example, researchers may expand the social network repertoire sampled to encompass all close friendships, rather than just college student peers, and incorporate a more global social network quality measure. Second, qualitative data collection methods, such as semi-structured interviews, could supplement comparatively more quantitative measures to understand the rich nature of individuals' social networks and relationships more in-depth, consistent with other studies focusing on positive social outcomes in BSDs (e.g., Lobban et al., 2012, Owen et al., 2017).

Finally, future studies could examine the bidirectional nature of reciprocal friendship networks (e.g., Tabassum et al., 2018) to understand whether elevated bipolar risk is associated with less reciprocal social network connections among peers.

Third, participants from the present study were a non-clinically diagnosed, analog sample, drawn from a general study of emotion and mental health in emerging adults. Although rates of psychopathology in such college student populations are generally high (e.g., Auerbach et al., 2018), we did not specifically recruit for participants who scored above clinical cut-offs for BSD risk nor did we attempt to oversample participants who scored on the higher end of our BSD risk scale distribution. As such, this may limit the clinical generalizability of the present investigation. Future investigations should aim to build on this work recruiting participants above high-risk clinical cutoff scores as well as oversample participants at the upper end of the score distribution. Additional work should seek to recruit DSM-5 clinically diagnosed samples of bipolar participants using standardized clinical interviewing procedures. Both of these approaches would facilitate understanding whether certain social connection dimensions may be more apparent at higher levels of BSD risk or in a clinically diagnosed sample.

Finally, we note some statistical approaches that should be considered when interpreting the present study findings. The effect sizes of our results indicating more adaptive or positive social connection outcomes were smaller compared to those of our social strain findings. Replication of these results in larger, clinically diagnosed samples are imperative before drawing major implications from the present findings. Furthermore, we note that we used listwise deletion to handle missing data. Future studies may want to consider other approaches to handling missing data (e.g., data estimation).

In summary, the present investigation revealed insights into associations between self-reported trait BSD risk and both social struggles and strengths. These findings suggest there may be distinct and multi-faceted social sides to bipolar disorder risk. This work underscores the importance of taking a comprehensive approach to understanding social network ties and mood risk among young adults and highlighting the role of social context in understanding mood onset and severity. Future work will continue to explore the complex ways social functioning is implicated in mood disturbance.

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Table 1
Demographics for the Full Sample and Each Site at Study Entry

	Full Sample (*N*=1934)	**CU Boulder (*n*=679)**	**UBC (*n*=197)**	**UC Berkeley (*n*=836)**	**UC Irvine (*n*=117)**	**UCL (*n*=105)**
Age *M* (*SD*)	19.25 (2.14)	18.32 (0.64)	18.21 (0.49)	20.47 (2.73)	18.19 (0.39)	18.67 (0.78)
Year in University	63.6% First 8.8% Second 13.7% Third 12.0% Fourth 1.2% Fifth 0.7% Sixth	100% First	100% First	15.8% First 20.3% Second 31.7% Third 27.8% Fourth 2.9% Fifth 1.6% Sixth	100% First	100% First
Gender	76% Female 23% Male .7% Trans/NB/Other	74% Female 26% Male .6% Trans/NB/Other	85% Female 15% Male .5% Trans/NB/Other	74% Female 25% Male .8% Trans/NB/Other	82% Female 17% Male .8% Trans/NB/Other	87% Female 13% Male
SES *M* (*SD*)	6.63 (1.60)	6.8 (1.43)	6.53 (1.36)	6.61 (1.77)	5.91 (1.51)	N/A
First-Gen	25% Yes 75% No	17% Yes 83% No	26% Yes 74% No	29% Yes 71% No	49% Yes 51% No	25% Yes 75% No
Ethnicity	46.3% White 38.1% Asian 11.1% Latinx 2.6% Black .7% Native American 8.3% Other	83.1% White 12.7% Asian 12.5% Latinx 3.4% Black 1.6% Native American 1.8% Other	28.9% White 62.9% Asian 2% Latinx .5% Black 10.7% Other	26.3% White 47.0% Asian 12% Latinx 2.8% Black .2% Native American 13.8% Other	11.1% White 69.2% Asian 21.4% Latinx 2.6% Black 0% Native American 3.4% Other	40% White 50.5% Asian 7.6% Other

Note. SES=Socioeconomic status; NB=Non-binary; CU Boulder=University of Colorado Boulder; UC Berkeley=University of California, Berkeley; UBC=University of British Columbia; UC Berkeley=University of California, Irvine; UCL=University College London.

Table 2.
Descriptive Statistics for the Full Sample for Primary Study Measures Across Full Sample and Separately by University Site

	Full Sample (*N*=1934)	**CU Boulder (*n*=679)**	**UBC (*n*=197)**	**UC Berkeley (*n*=836)**	**UC Irvine (*n*=117)**	**UCL (*n*=105)**
	M (*SD*) *Skewness* *Kurtosis*	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
HPS-20 (0-19)	7.96 (4.03) *0.207* *-0.661*	8.29 (3.9)	7.83 (4.0)	7.68 (4.16)	8.22 (3.87)	8.03 (3.91)
DSM5-Dep (0-4)	1.98 (1.18) *0.042* *-0.887*	1.77 (1.19)	2.09 (1.07)	2.08 (1.19)	2.21 (1.09)	2.1 (1.1)
DSM5-Mania (0-4)	1.49 (1.24) *0.287* *-1.075*	1.7 (1.25)	1.47 (1.18)	1.32 (1.21)	1.63 (1.2)	1.43 (1.28)
ASRM (0-20)	6.02 (3.76) *0.443* *-0.261*	6.76 (3.64)	5.95 (3.95)	5.41 (3.75)	5.69 (3.48)	6.48 (3.64)
Social Network Quantity (0-38)	7.06 (4.70) *1.319* *1.854*	5.87 (3.68)	6.31 (3.69)	8.73 (5.33)	5.24 (3.84)	5.06 (3.51)
Social Network Quality (0-9)	3.61 (2.03) *0.611* *-0.366*	--	3.33 (1.93)	3.69 (2.05)	3.47 (2.04)	--

Social Support (1-4)	3.31 (0.64) *-0.938* *0.332*	3.37 (0.63)	3.36 (0.59)	3.26 (0.65)	3.33 (0.64)	3.30 (0.63)
Social Strain (1-4)	2.02 (0.59) *0.448* *0.162*	2.17 (0.54)	2.03 (0.47)	1.86 (0.62)	2.12 (0.55)	2.06 (0.53)

Note. CU Boulder=University of Colorado Boulder; UC Berkeley=University of California, Berkeley; UBC=University of British Columbia; UC Berkeley=University of California, Irvine; UCL=University College London.

Table 3.

Bivariate Correlations Between Primary Study Measures

	HPS-20	DSM5-Dep	DSM5-Mania	ASRM	SN-Quantity	SN-Quality	Social Support	Social Strain
HPS-20	--	0.19**	0.32**	0.24**	0.06**	0.08**	0.02	0.21**
DSM5-Dep		--	0.23**	-0.28**	-0.09**	-0.11**	-0.29**	0.18**
DSM5-Mania			--	0.22**	0.01	0.04	-0.06*	0.23**
ASRM				--	0.10**	0.18**	0.23**	0.00
SN-Quantity					--	0.55**	0.14**	-0.04
SN-Quality						--	0.29**	-0.04
Social Support							--	-0.25**
Social Strain								--

Note: HPS-20=Hypomanic Personality Scale; DSM5-Dep=DSM-5 Cross Cutting Symptom Measure, depression subscale; DSM5-Mania=DSM-5 Cross Cutting Symptom Measure, mania subscale; ASRM=Altman Self-Rating Mania Scale; SN-Quantity=Social Network Scale, number of friends; SN-Quality=Social Network Scale, mean of friends to share good or bad news with; Social Support=Perceived Social Support Scale; Social Strain=Perceived Social Strain Scale. *p <.05; **p<.01.

Table 4a.
Associations Between BSD Risk and Social Struggles (Aim 1)

	Aim 1a: SN-Quality			**Aim 1b: Social Strain**		
Predictor	R^2	β	CI	R^2	β	CI
Block 1	.001	-	-	.022**	-	-
(Demographics)	-	-	-	-	-	-
Age	-	-.009	-.06, .05	-	-.127**	-.048, -.024
Sex	-	-.024	-.411, .175	-	.062**	.027, .147
Block 2	.038**	-	-	.088**	-	-
(Current Mood Symptoms)	-	-	-	-	-	-
DSM-Dep	-	-.084*	-.261, -.035	-	.109**	.031, .078
DSM-Mania	-	-.008	-.122, .096	-	.151**	.049, .094
ASRM Mania	-	.150**	.045, .116	-	-.059*	-.017, -.002
Block 3	.042**	-	-	.107**	-	-
(BSD Risk)	-	-	-	-	-	-
HPS-20	-	.063+	-.001, .063	-	**.152****	.015, .029

Note: HPS-20=Hypomanic Personality Scale, 20-item version; DSM5-Dep=DSM-5 Cross Cutting Symptom Measure, depression symptom domain subscale; DSM5-Mania=DSM-5 Cross Cutting Symptom Measure, mania symptom domain subscale;

ASRM=Altman Self-Rating Mania Scale; SN-Quantity=Social Network Scale, number of friends; SN-Quality=Social Network Scale, mean number of friends sharing to share good or bad news with; Social Support=Perceived Social Support Scale; Social Strain=Perceived Social Conflict Scale. β = Standardized beta coefficient (individual beta values are from Module 3). R^2 reflects significance from overall Model in that Block.

+p<.10. *p <.05; **p<.01.

Table 4b.

Associations Between BSD Risk and Social Strengths (Aim 2)

	Aim 2a: SN-Quantity			**Aim 2b: Social Support**		
Predictor	R^2	β	*CI*	R^2	β	*CI*
Block 1	.004*	-	-	.007**	-	-
(Demographics)	-	-	-	-	-	-
Age	-	.081**	.081, .287	-	-.009	-.016, .010
Sex	-	-.027	-.807, .199	-	-.083**	-.189, -.061
Block 2	.020**	-	-	.114**	-	-
(Current Mood Symptoms)	-	-	-	-	-	-
DSM-Dep	-	-.806**	-0.543, -0.142	-	-.233**	-.151, -.100
DSM-Mania	-	-.008	-0.217, 0.158	-	-.054*	-.052, -.004
ASRM Mania	-	.071**	0.026, 0.153	-	.171**	.021, .037
Block 3	.024**	-	-	.116*	-	-
(BSD Risk)	-	-	-	-	-	-
HPS-20	-	**.072****	0.027, 0.142	-	**.050***	.001, .015

Note: HPS-20=Hypomanic Personality Scale, 20-item version; DSM5-Dep=DSM-5 Cross Cutting Symptom Measure, depression symptom domain subscale; DSM5-Mania=DSM-5 Cross Cutting Symptom Measure, mania symptom domain subscale; ASRM=Altman Self-Rating Mania Scale; SN-Quantity=Social Network Scale, number of friends; SN-Quality=Social Network Scale, mean number of friends sharing to share good or bad news with; Social Support=Perceived Social Support Scale; Social Strain=Perceived Social Conflict Scale. β = Standardized beta coefficient (individual beta values are from Module 3). R^2 reflects significance from overall Model in that Block.

+p<.10. *p <.05; **p<.01.

Supplementary Materials for Ibonie et al.

Supplementary Materials Part 1: Social Network Measures at UC Berkeley Site

The present investigation was part of a larger study protocol originating at the University of Colorado, Boulder (UC Boulder) with 11 collaborating Universities including: New York University, USA; University of California, Berkeley, USA; University of California, Irvine, USA; University of Georgia, USA; San Francisco State University, USA; Temple University, USA; Northwestern University, USA; the University of British Columbia, Canada; and the University of College London, UK; Swinburne University, Melbourne, Australia; and Karnatak University, India.

The present investigation retained study data from five university sites which had all relevant social network dimension and mood measures. These five sites that participated in the present study included the: University of Colorado Boulder, University of California Irvine, University of British Columbia, and the University College London. Participants were asked to list social network information only for peers in the same year at university as them (e.g., first-year college students). This is in congruence with past literature using the same study measures (e.g., Morelli et al., 2017; Parkinson et al., 2018) with the rationale to focus only on immediate peer networks. University of California Berkeley allowed all undergraduate college students who met eligibility criteria (e.g., between ages 18-25 and fluent in English) to participate in the study. Therefore, students at UC Berkeley were presented with slightly different item wording allowing them to list friends who were not just first-year students. Specifically, UC Berkeley students saw the following question text for the Social Network Quantity (SN-Quantity) measure: "*Consider the people with whom you like to spend your free time. Since you arrived at UC Berkeley, who are the classmates you have been with most often for informal social activities, such as going out*

to lunch, dinner, drinks, films, visiting one another's homes, and so on? Please list the first and last initials of as many UC Berkeley students as you would like below (use commas to separate each student)". For the Social Network Quality (SN-Quality) measure, UC Berkeley students were presented with the following question text: "*In response to each of the following questions, please type in the initials of up to 8 UC Berkeley students ONLY. Please do NOT list any people outside of UC Berkeley (e.g., family, significant others, other friends on/off campus).*" The questions (1) "*Who do you share good news with?*" (i.e., SN-Quality Good News) and (2) "*Who do you turn to when something bad happens?*" (i.e., SN-Quality Bad News) were consistent across all participants and University sites and did not differ for UC Berkeley students.

Supplementary Materials Part 2: Preliminary Bivariate Correlations

We conducted bivariate correlations among all main study variables. As seen in **Table S2**, the primary measures were correlated largely in expected directions. Specifically, HPS-20 was positively associated with increased DSM5-Depression ($r(1931) = 0.188$, $p < .001$), DSM5-Mania ($r(1931) = 0.323$, $p < .001$), ASRM ($r(1931) = 0.237$, $p < .001$), SN-Quantity ($r(1905) = 0.066$, $p < .05$), SN-Quality ($r(1107) = 0.078$, $p < .05$) and Social Strain ($r(1932) = 0.215$, $p < .001$) but not associated with Social Support ($r(1932) = 0.019$, $p = 0.395$). The DSM5-Dep was positively associated with DSM5-Mania ($r(1933) = 0.227$, $p < .001$) and Social Strain ($r(1933) = 0.179$, $p < .001$), and negatively associated with the ASRM ($r(1932) = -0.281$, $p < .001$), SN-Quantity ($r(1906) = -0.084$, $p < .001$), SN- Quality ($r(1108) = -0.110$, $p < .001$), and Social Support ($r(1933) = -0.286$, $p < .001$). The DSM5-Mania was positively associated with ASRM ($r(1932) = 0.217$, $p < .001$) and Social Strain ($r(1933) = 0.226$, $p < .001$), negatively associated with Social Support ($r(1933) = -0.058$, $p < .05$), and had no relationship with SN-Quantity ($r(1906) = 0.005$, $p = 0.815$) or SN-Quality ($r(1108) = 0.037$, $p = 0.225$). The ASRM was

positively associated with SN-Quantity ($r(1906) = 0.096$, $p < .001$), SN-Quality ($r(1108) = 0.182$, $p < .001$), and Social Support ($r(1933) = 0.232$, $p < .001$)), and had no relationship with Social Strain ($r(1933) = 0.004$, $p = 0.869$). SN-Quantity was positively associated with SN-Quality ($r(1086) = 0.549$, $p < .001$), Social Support ($r(1907) = 0.137$, $p < .001$), and had no relationship with Social Strain ($r(1907) = -0.040$, $p = 0.082$). SN-Quality was positively associated with Social Support ($r(1109) = 0.289$, $p < .001$) but not with Social Strain ($r(1109) = -0.043$, $p = 0.154$). Finally, Social Support was negatively associated with Social Strain ($r(1934) = -0.247$, $p <. 001$).

Supplementary Materials Part 3: Socioeconomic Status as a Potential Moderator

Given the relationship between socioeconomic status (SES) on a multitude of psychosocial outcomes (e.g., Campbell et al., 1986), we found it important to include SES as a covariate in our model. We ran post-hoc analyses to understand how SES may affect social connection in BSD populations and potentially moderate the relationship between mania risk and connection outcomes.

First, we examined the distributions of SES following the same previous guidelines for data distribution cutoffs (i.e., skewness indices of +/-2 and kurtosis indices of +/-7; Hair et al., 202; Kim, 2013). Skewness and kurtosis were both within the appropriate ranges (skew -0.57; kurtosis 0.25). Second, we conducted bivariate correlations between SES and all main study variables. As seen in **Table S2,** we found significant positive associations between our positive social outcome variables (i.e., SN-Quantity, SN-Quality, and Social Support). We did not find a significant association between SES and social strain but they were negatively correlated. **Table S2** shows directionality of relationships.

Given the significant associations we found between our social connection variables and SES we re-ran our analyses adding SES to our models. To examine possible interactions between our other study covariates and SES, we used a fully interactive model to investigate the relationships between SES and our outcome variables. Specifically, we were interested in whether SES may moderate the relationship between mania risk and our social connection variables. To investigate SES in our interactive model we mean centered all continuous independent variables (i.e., Age, SES, HPS-20, DSM5-Dep, DSM5-Mania, and ASRM). Second, we scaled our covariates to be numeric values as opposed to matrix types to allow graphing of the interactions. Third, we looked at the interactions between SES and our predictor variable (e.g., HPS) and other covariates (e.g., Age, Sex, Depression, DSM5 Mania, and ASRM Mania).

Re-examining study Aim 1A with SES and interactions added we found that there was a significant positive relationship between SES and SN-Quality ($\beta = 0.158$; $p < .001$). Once we added SES to the model, the previously found relationship between SN-Quality and HPS was no longer significant ($\beta = 0.061$; $p = .060$). There was no significant interaction between SES and HPS however there was between SES and current elevated mood (ASRM-Mania: $\beta = -0.030$, $p = .016$). When re-examining our study Aim 1B our previously found results did not change. HPS was still significantly associated with Social Strain ($\beta = 0.155$, $p < .001$). There was no significant relationship between SES and Social Strain. Of our covariates, the only significant interaction that was observed was between SES and Gender ($\beta = -0.101$, $p = 0.048$). This supports that our previously found results indicating a positive relationship between mania risk and social strain are our most robust findings, with the strongest effect sizes. Re-examining our Aim 2A analyses we found that SES was significantly associated with Quantity ($\beta = 0.151$, $p < .001$), yet even when adding SES to the model HPS was still significantly associated with SN-

Quantity (β = 0.065, $p < .05$). There was also a significant interaction between SES and HPS (β = 0.068, $p < .05$) and SES and Age (β = 0.074, $p < .001$). Finally, when re-examining our study Aim 2B we found that the relationship between HPS and Social Support was insignificant (β = 0.045, $p = .063$). There was, however, a significant association between SES and Social Support (β = 0.142, $p <.001$). There were no significant interactions between SES and any covariates in our Aim 2B model.

In summary, SES may be an important predictor for socially adaptive outcomes but doesn't seem to be a driving predictor when it comes to social conflict. In turn, it seems that social strain is robustly related to mania risk, over and above SES. When we add SES as a covariate, some of our weaker findings become non-significant. The only main result finding that holds is the relationship between mania risk and social strain. When we add SES to our models, the relationship between mania risk and our socially adaptive variables (i.e., SN-Quality, Social Support) are no longer significant. While this does not necessarily mean that SES is the driving predictor, it does mean that our previous findings were not robust enough to hold when we added another predictor to the model. This is not surprising, given the small effect sizes for our models social adaptive outcomes (e.g., Quality, and Connection) compared to the stronger effect sizes observed in our Social Strain model.

We also found that SES did not interact with Mania Risk in any of our study models. However, there were interactions observed between SES and other covariates in our Social Network (e.g., Quality and Quantity) models and our Social Strain model. First looking at our interactions in Study Aim 1, examining associations between BSD risk and social disconnection, in our Aim 1A results examining Mania Risk and SN-Quality, there was a significant positive interaction between SES and elevated mood (ASRM Mania), meaning that there is more of an

impact of elevated mood on increased SN-Quality for people who are of higher socioeconomic backgrounds **(Figure S1)**. In examining our Aim 1B examining Mania Risk and Social Strain, there was a significant negative interaction between SES and Sex, showing that there was a stronger effect of SES on Social Strain for males than females **(Figure S2)**. In examining our Aim 2 results, looking at associations between BSD risk and social connection, our Aim 2A findings looking at mania risk and SN-Quantity there was a significant positive interaction between SES and age, meaning that the relationship between age and SN-Quantity is stronger for people of higher SES **(Figure S3)**.

In sum, we found that SES did not moderate the relationship between mania risk and any of our social connection indices; however there were interesting associations between SES and our social connection study variables. Specifically, social network quality and social connection were positively associated with SES, and mania risk dropped away as a significant predictor of positive social outcomes. Indeed, our most robust finding remained that mania risk is strongly associated with more social strain in relationships, which is consistent with past literature (e.g., Eidelman et al., 2012). These findings imply that mania risk is indeed strongly associated with social strain in peer-relationships; and that SES may play a more important role in positive social connection outcomes.

Figure 1.

Social Network Quality and Socioeconomic Status x Elevated Mood

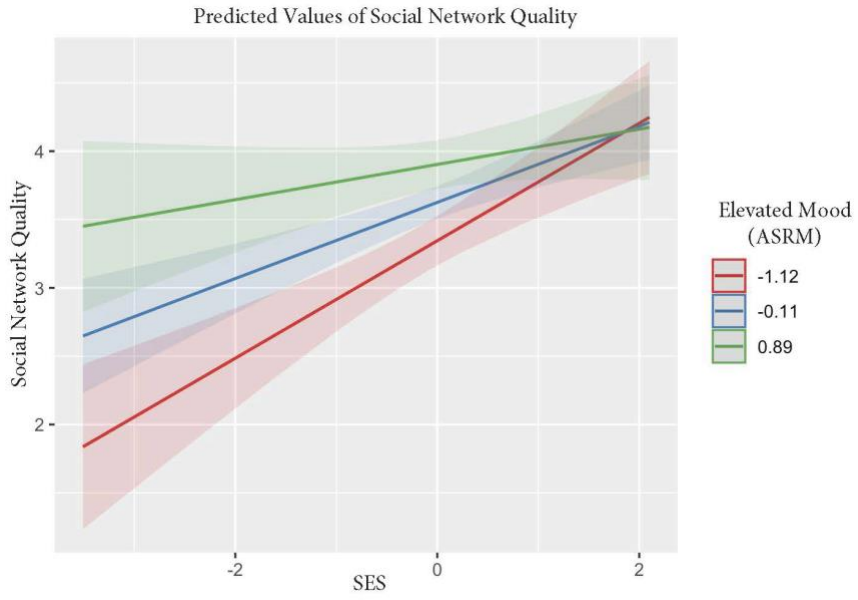


Figure S2.

Social Conflict and Socioeconomic Status x Gender

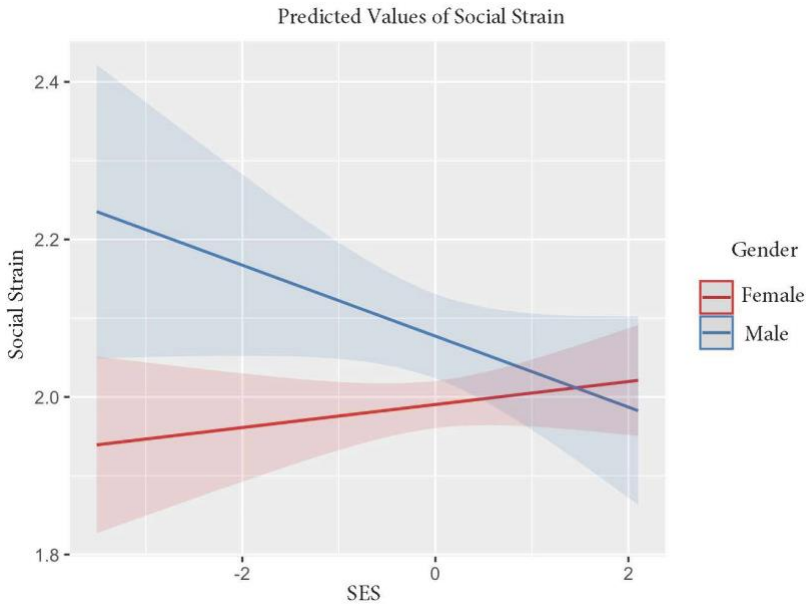
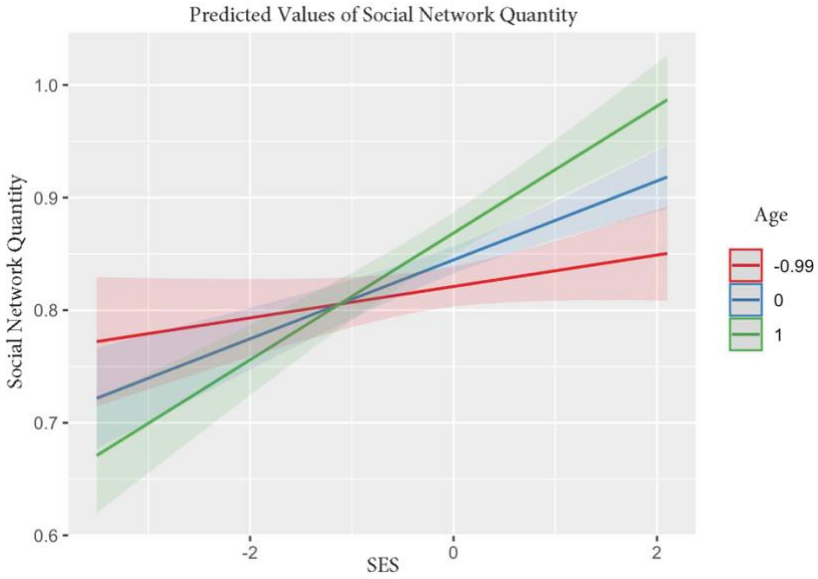


Figure S3.

Social Network Quantity and Socioeconomic Status x Age



Supplementary Materials Part 4: Considering Analyses without Symptom Influence

Post-hoc analyses also examined whether results held when removing participants from the data who were experiencing clinical levels of elevated mania or depression mood symptoms. To examine this, we removed participants who scored above clinical cutoffs on our current symptom measures (i.e., ≥ 14 on ASRM; ≥ 3 on DSM5-Depression and DSM-5 Mania). We removed a total of 947 participants (*N*=988). 3.2% (*N*=61) of participants scored above threshold cutoffs for current elevated mood on the ASRM. 34.9% (*N*=674) of participants scored above threshold cutoffs for current depressed mood on DSM5-Depression, and 25.2% (*N*=488) of participants scored above threshold cutoffs for current manic mood on DSM5-Mania. Note that these percentages are non-exclusive and there was a significant amount of overlap between participants endorsing elevated mood symptoms, indicating the level of possible comorbidity in the sample of removed participants.

Second, we re-ran our main analyses using this subsample. We also removed current symptoms from Block 2 given current mood was controlled by removing participants who were elevated on depressive and manic mood symptoms. As with our original analyses, we included demographic (i.e., Age & Sex) variables in Block 1 and BSD risk in Block 2. We first re-examined Aim 1, looking at the relationship between mania risk and social disconnection. As seen in **Table S3**, results for Aim 1A, Block 1 examining the relationship between our demographic variables and SN-Quality were insignificant (Model 1: $F(2, 538) = .972$, $p = .379$). Similarly, when we added our mania risk variable in Block 2 our regression statistics remained insignificant (Model 2: $F(3, 537) = .982$, $p = .401$). As seen in **Table S3**, when we re-examined Aim 1B, Block 1 examining the relationship between our demographic variables and Social Strain we found a significant relationship (Model 1: $F(2, 977) = 18.09$, $p < .001$). We also found

that our previously observed results indicating a relationship between mania risk (HPS-20) and Social Strain held (Model 2: $F(3, 976) = 21.19$, $p < .001$). This once again supports our findings indicating that the results indicating a positive relationship between mania risk and social strain are the most robust findings in the present study. Next wet re-examined study Aim 2, looking at the relationship between mania risk and social connection. As seen in **Table S4** results for Aim 2A, Block 1 examining the relationship between our demographic variables and SN-Quantity were found to be insignificant (Model 1: $F(2, 964) = 1.479$, $p = .228$). Similarly, Block 2 examining the relationship between Mania Risk (HPS-20) and SN-Quantity yielded insignificant results (Model 2: $F(3, 963) = 1.651$, $p = .176$). Finally, as seen in **Table S4**, results for Aim 2B, Block 1 examining the relationship between our demographic variables and Social Support were found to be significant (Model 1: $F(2, 977) = 3.429$, $p < .05$) for Age but not Sex. When adding mania risk (HPS-20) to the model in Block 2 results were significant (Model 1: $F(3, 976) = 2.809$, $p < .05$) however no individual β values in this final model were significant.

In sum, these post-hoc findings revealed similar findings as in our first set of post-hoc analyses, in which the relationship between mania risk and social strain appeared to be the most robust finding. In contrast, the previously observed relationships between social network quantity and connection and mania risk were no longer significant. This demonstrates to us that the relationship between social strain and mania risk is the strongest and most reliable finding of the present investigation; and that there may be something unique about the association between mania risk and positive social connection outcomes in participants who are currently experiencing heightened emotion or mood states. It may be worth future investigators taking a closer look at the relationship between mania risk and positive social outcomes in patients experiencing heightened mood states, as no such research has been done to date.

Supplementary Materials Part 5: Full Survey Measures List

Table S1. List of All Survey Measures Administered During the Fall 2019 and Spring 2020 (pre-COVID) Semesters

Measure	Scale Citation
Participant Characteristics	
Study ID number	n/a
Demographic questions	n/a
Social media use questionnaire	n/a
Health Information Questionnaire	n/a
Counseling and Treatment Questionnaire	Sachs, et al. (2003)
Current medication use (past month)	n/a
Affective Decision-Making and Behavior	
CARE	Fromme et al. (1997)
SUPPS-P	Cyders et al. (2014)
Monetary Choice Questionnaire	Kirby et al. (1999)
Behavioral Activation System-Reward Responsiveness	Carver & White (1994)
Modified Differential Emotions Scale	Cohn et al. (2009)
Subjective Happiness Scale	Lyubomirsky & Lepper (1999)
Satisfaction with Life Scale	Diener et al. (1985)
Valuing Happiness Scale	Mauss et al. (2010)
Fear of Happiness Scale	Joshanloo (2013)
Emotion Regulation Questionnaire	Gross & John (2003)
Emotion and Decision Making Beliefs	Gatchpazian (2019)
Emotion Control Beliefs items 1-4	Tamir et al. (2007)
Emotion Control Beliefs items 5-16	Mauss et al. (2010)
Domain-Specific Impulsivity in Children	Tsukayama et al. (2013)
Brief Resilience Scale	Smith et al. (2008)
Positive Emotion Persistence	Gruber et al. (in-prep)
Psychological Adjustment	
DSM-5 Cross Cutting Measure	American Psychiatric Association (2013b)
Patient Safety Screener-3	Boudreaux et al. (2015)
Non-Suicidal Self Injury	Simms & Clark (2006)
Hypomanic Personality Scale (20 item)	Eckblad & Chapman (1986)
Altman Self-Rating Mania Scale	Altman et al. (1997)
Family Index of Risk for Mood	Algorta et al. (2013)
PROMIS	Yu et al. (2011)
Alcohol Quantity and Frequency	Rehm (1998)
Alcohol Problems Questionnaire	White & Labouvie (1989)
Perceived Stress Scale	Cohen et al. (1983)
Drug Abuse Screening Test (10 item)	Bohn et al. (1991)

Cannabis Use and Problems	Bashford et al. (2010)
Healthy Living Questionnaire	Ware et al. (2001)
Prodromal Psychosis Questionnaire	Loewy et al. (2011)
Social Functioning	
Perceived Social Support and Conflict	Schuster et al., (1990); Whalen & Lachman (2000)
Social Identity Scale at CU Boulder	Leach et al. (2008)
Belonging Uncertainty Scale	Walton & Cohen (2007)
SN-Quantity	Wheatley et al. (2018)
SN-Quality	Morelli et al. (2017)
Academic Adjustment	
Academic Self-Efficacy	Gaumer-Erickson et al. (2016)
Miscellaneous	
Brief Social Desirability Scale	Haghighat (2007)
Attention Check Catch Items	n/a

Note: n/a = Not officially published scale.

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Table S2.

Bivariate Correlations Between SES & Primary Study Measures

	SES	SN-Quantity	SN-Quality	Social Support	Social Strain
SES	--	0.15**	0.15**	0.19**	-0.04
SN-Quantity		--	0.55**	0.14**	-0.04
SN-Quality			--	0.29**	-0.04
Social Support				--	-0.25**
Social Strain					--

Note: SES = Socioeconomic Status; SN-Quantity = Social Network Scale, number of friends; SN-Quality = Social Network Scale, mean of friends to share good or bad news with; Social Support = Perceived Social Support Scale; Social Strain = Perceived Social Strain Scale

Table S3.

Post-Hoc Analyses 2: Associations Between BSD Risk and Social Disconnection (Excluding Elevated Mood).

	Aim 1a: SN-Quality			Aim 1b: Social Strain		
Predictor	R^2	β	*CI*	R^2	β	*CI*
Block 1	.004	-	-	.036**	-	-
(Demographics)	-	-	-	-	-	-
Age	-	-.032	-0.109, 0.049	-	-.165**	-0.067, -0.031
Sex	-	-.047	-0.648, 0.186	-	.070*	0.013, 0.174
Block 2	.005	-	-	.061**	-	-
(BSD Risk)	-	-	-	-	-	-
HPS-20	-	.043	-0.020, 0.061	-	**.160****	0.014, 0.030

Note: HPS-20 = Hypomanic Personality Scale, 20-item version; SN-Quantity = Social Network Scale, number of friends; SN-Quality = Social Network Scale, mean number of friends sharing to share good or bad news with; Social Support = Perceived Social Support Scale; Social Strain = Perceived Social Strain Scale

*p <.05; **p<.01.

Table S4.

Post-Hoc Analyses 2: Associations Between BSD Risk and Social Connection (Excluding Elevated Mood).

	Aim 2a: SN-Quantity			Aim 2b: Social Support		
Predictor	R^2	β	*CI*	R^2	β	*CI*
Block 1	0.010	-	-	.007*	-	-
(Demographics)	-	-	-	-	-	-
Age	-	.093*	0.076, 0.392	-	-.060	-0.038, 0.001
Sex	-	-0.0445	-1.189, 0.202	-	-.052	-0.159, 0.014
Block 2	0.011	-	-	.009	-	-
(BSD Risk)	-	-	-	-	-	-
HPS-20	-	.043	-0.023, 0.122	-	.040	-0.003, 0.015

Note: HPS-20 = Hypomanic Personality Scale, 20-item version; SN-Quantity = Social Network Scale, number of friends; SN-Quality = Social Network Scale, mean number of friends sharing to share good or bad news with; Social Support = Perceived Social Support Scale; Social Strain = Perceived Social Strain Scale

*p <.05; **p<.01.