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Patterns of Stress Generation differ depending on Internalizing Symptoms, Alcohol Use, and Personality Traits in early Adulthood: a Five Year Longitudinal Study

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Abstract

Background: Depression is thought to generate stressful life events. However, other internalizing symptoms such as anxiety or post-traumatic stress and individual difference variables such as personality traits and alcohol use may contribute to stressful life events. Whether stress generation is specific to depression or generalized to these other variables is unclear. Therefore, we tested whether stress generation was depression specific or generalizable to anxiety, PTSD, alcohol use, neuroticism, and extraversion.

Design: Two-wave longitudinal study with a five-year follow-up.

Methods: 917 young adults completed measures of internalizing symptoms, alcohol use, neuroticism, and extraversion during college and five years later along with an interview-based measure of life events.

Results: Symptoms of depression, anxiety, PTSD, and neuroticism exhibited bivariate predictive effects on interpersonal-dependent events. When considering internalizing symptoms in the aggregate, stress generation was specific to symptoms rather than neuroticism. Furthermore, interpersonal-dependent life events mediated Time 1 internalizing symptoms predicting Time 2 symptoms.

Conclusion: Our results indicate that stress generation applies to internalizing symptoms broadly rather than specifically to depression. Moreover, neuroticism was no longer a significant predictor of life events when examined with internalizing symptoms simultaneously. These results support the value of integrative models that test numerous factors predicting stressful life events.

Introduction

The stress generation hypothesis proposes that individuals with a history of depressive diagnoses or symptoms elicit stressful life events as a result of their own behavior (Hammen, 1991; Liu & Alloy, 2010). In this way, a vicious cycle occurs in which those with depression contribute to unfavorable environments, thus perpetuating or exacerbating symptoms. The stress generation hypothesis has expanded to include other forms of psychopathology and additional variables that may influence the stress generation process (Conway et al., 2012; Kushner et al., 2017). In line with this broader perspective, we examined stress generation to include different forms of internalizing symptoms of depression, anxiety, and post-traumatic stress disorder (PTSD). We also considered neuroticism and extraversion, personality traits that may also contribute to stress generation. Lastly, we considered the influence of alcohol use as a stress-related problem that is often over looked in this area of research.

Stressful life event measurement

To understand the stress generation literature, it is important to first discuss how life events are measured (Harkness & Monroe, 2016). Event types are often characterized as interpersonal or non-interpersonal. Others also designate achievement-related events (Shapero et al., 2013) as interpersonal- and achievement-related losses are predictive of depression (Kendler et al., 2003). Additionally, the degree to which stressful life events are dependent on one's behavior is considered. Independent events (termed fateful events) are those that a person is believed to have no control over, whereas dependent events explicitly result largely or in part from one's behavior. Dependency of events are particularly relevant to stress generation, as these events by definition are influenced by the individual (Hammen, 2006; Liu & Alloy, 2010).

Internalizing symptoms

Anxiety, depression, and PTSD are closely related to one another and often labeled under the broader umbrella term internalizing pathology (Kotov et al., 2017). Although depression has received the bulk of attention in stress generation research, it stands to reason that closely related symptoms may also exhibit stress generation (Connolly et al., 2010).

Stress generation is supported for depression in adolescent and adult populations (Liu & Alloy, 2010). In particular, dependent interpersonal life events are most consistently found to be associated with depression or depressive symptoms; although, some studies find that depressive symptoms predict stressful life events in general (Harkness & Stewart, 2009; Kercher et al., 2009). Furthermore, the strongest support for the stress generation model

comes from longitudinal mediation studies where depressive symptoms predict stressful life events, which in turn predict subsequent symptoms (Goldstein et al., 2019; Holahan et al., 2005).

Pathologies closely related to depression, such as anxiety, are increasingly included in stress generation studies. Cross-sectionally, individuals with comorbid depression and anxiety diagnoses demonstrate higher rates of interpersonal dependent life events compared to those with only depression or only anxiety (Connolly et al., 2010), suggesting the plausibility of stress generation in those with anxiety. Related constructs such as anxious attachment may also predict stressful life events (Hankin et al., 2005). In some longitudinal research, anxiety symptoms have been found to predict stressful life events (Jeronimus et al., 2013; Uliaszek et al., 2012) and anxiety may be even more strongly related to stressful events than depressive symptoms (Phillips et al., 2015). However, some studies have demonstrated that stress generation is specific to depressive symptoms rather than anxiety, or that depression is more strongly associated with stress generation relative to anxiety (Conway et al., 2012; Joiner et al., 2005). Overall, these studies suggest that depression and anxiety may exhibit similar stress generation qualities.

Most stress generation studies have not included PTSD, which is unfortunate as PTSD is uniquely defined by exposure to a traumatic event and is often comorbid with depression (O'Donnell et al., 2004). Furthermore, after an index traumatic event, exposure to additional stressful life events following trauma are associated with PTSD diagnosis (Brewin et al., 2000). Studies that have examined PTSD find that it predicts negative life events, supporting the stress generation model (but see, Sadeh, Miller, Wolf, & Harkness, 2015). Importantly, there is some indication that PTSD symptoms predict life events, which in turn predict PTSD, a pattern similarly observed in studies of depression (Maniates et al., 2018).

Personality and stress generation

Personality traits have been considered a key variable in stress-related processes for several decades. Indeed, in the early formulations of the stress generation hypotheses, Hammen (1991) referenced the depressed person's "characteristics" as contributing to generating events. We focus on neuroticism and extraversion, which have been studied most extensively in generating stress. Although neuroticism exhibits considerable overlap with internalizing symptoms, they are distinct constructs (e.g., Ormel et al., 2013). The nature of their interrelationship is complex, comprising a rich literature on its own and a thorough discussion is beyond the scope of this article. At the very least, neuroticism cannot be considered as redundant with internalizing symptoms as neuroticism is also associated with psychopathology broadly rather than internalizing alone (Caspi et al., 2014). Despite the overlap between neuroticism and depression, it is important to establish whether stress generation is attributable to only symptoms, traits, or both. Existing research finds that elevated neuroticism predicts a range of interpersonal and achievement related stressful events (Jeronimus et al., 2013; Uliaszek et al., 2012; Vaidya et al., 2002) and perhaps dependent life events in particular (Kercher et al., 2009; Wetter & Hankin, 2009), whereas extraversion does not predict events (Spinhoven et al., 2011).

Neuroticism and extraversion have been included in the few psychopathology studies of stress generation to date (Kushner et al., 2017) and these studies have typically focused on depression. In one study, neuroticism was found to be a unique predictor of life events, even when covarying for depression symptoms (Kercher et al., 2009) and others have found that neuroticism and symptoms of anxiety or depression each uniquely predict events (Uliaszek et al., 2012). However, others have found that depression, but not neuroticism significantly predict stressful life events (Goldstein et al., 2019). In perhaps the only stress generation study that examined PTSD and personality simultaneously, negative emotionality (akin to neuroticism) was a significant predictor of stressful life events, but PTSD symptoms were not (Sadeh et al., 2015). These initial studies are somewhat mixed as to whether neuroticism, symptoms, or both affect stress generation.

Alcohol use and stress generation

Problematic alcohol use is not typically included in stress generation research, but problematic use may lead to stressful life events. First, it is notable that stressors are implicated in the onset, maintenance, and relapse of problematic alcohol use (Keyes et al., 2011; Pilowsky et al., 2013). Indeed, drinking in response to stress (e.g., drinking to cope) may be particularly concerning in those with a history of problematic alcohol use (Cooper et al., 2016; Keyes et al., 2011). Similar to depression, interpersonal- and achievement-related events may have the strongest influence on problematic use (Pilowsky et al., 2013). Most relevant to stress generation is that alcohol use predicts various stressful life events. Alcohol use is a predictor of school or work absenteeism (French et al., 2011), divorce (Collins et al., 2007), and increased exposure to stressful life events in general (Hart & Fazaa, 2004). In addition, common measures of drinking-related problems often assess how alcohol use results in interpersonal conflict (Read et al., 2006). These findings, coupled with the comorbidity between alcohol use and depression (Brière et al., 2014), warrant including alcohol use as a predictor of stressful life events.

The current study

Stress generation has expanded well beyond its original formulation, spawning a large literature including many constructs. Nevertheless, important questions remain. In particular, additional research is needed to explore the effect of stress generation on internalizing symptoms more generally and whether the same types of events are consistently predicted by particular forms of internalizing symptoms, such depression, anxiety, and PTSD. Additionally, there is variability across studies regarding the role of personality traits. Furthermore, despite the robust associations between alcohol use and stressful life events, alcohol use is absent from stress generation studies of depression. These issues highlight the need for integrative approaches that include multiple sources of stress generation within the same analytic models.

Therefore, the current study aimed to clarify the role of depression, anxiety, and PTSD symptoms in predicting stressful life events, while also considering personality traits and alcohol use in a large sample first assessed in college and then followed-up five years later. Given past research on stress generation, anxiety, depression, and PTSD, we suspected that a broader internalizing symptom aggregate would predict stressful life events,

especially dependent interpersonal events, but not independent events. Furthermore, we anticipated that interpersonal dependent stressful life events would then predict subsequent internalizing symptoms at follow-up. Therefore, we examined life events as a mediator of internalizing symptoms from wave 1 to wave 2, which tests the part of the stress generation model that posits life events as maintaining the continuity or worsening course of symptoms and is the analytic model used in previous studies (e.g., Holahan et al., 2005). Within that same model, we examined whether life events would also function as a mediator of neuroticism, extraversion, and alcohol use. With regard to hypotheses, we suspected that depression, anxiety, PTSD, neuroticism, and alcohol use would individually predict dependent interpersonal life events, but extraversion would not predict life events. Achievement related events have been examined less in prior research, precluding our ability to make firm hypotheses. Additionally, we did not anticipate that symptoms, alcohol use, or personality would predict independent events, which are by definition, supposed to be unrelated to individual difference variables. We also examined sex differences which have been found in some studies (e.g., Shapero et al., 2013); however we did not have hypotheses for sex as prior studies have not included the same set of predictors as those used in the current study.

Methods

Participants

These data are drawn from a large, longitudinal sample examining alcohol use during college and five years later (Armeli et al., 2014, 2018). College students were recruited over the course of nine semesters via the psychology research pool, campus-wide emails, and flyers resulting in 1,818 participants. Procedures were approved by the institutional review board of the University of Connecticut and its School of Medicine. Students were eligible for baseline if they reported drinking alcohol at least twice in the past month, had not received alcohol use treatment, and were at least 18. Follow-up assessment was conducted five years later and focused on those who had been moderate to heavy drinkers in the initial college assessments, such that 1142 (62.8% of original sample) participants that had at least one heavy drinking day during the college assessment period (4 drinks for women and 5 drinks for men) in both a 30-day retrospective assessment and a 30-day daily diary reporting phase were contacted (see Armeli et al., 2018). Finally, given our focus on changes in drinking from college life to post-college life, participants needed to have graduated or been no longer working towards an undergraduate degree. Nine hundred twenty seven participants engaged in both assessment waves and 917 had useable data for the current analyses. Self-report data were collected via a secure website at both time points. At baseline, participants completed several measures including, past 30-day alcohol use, personality, and internalizing symptoms (PTSD, anxiety, and depression). The anxiety assessment was added shortly after the baseline assessment began. The internalizing symptom score was determined by z-scoring and then averaging three different scales described below. At follow-up participants repeated the same measures, as well as a measure of past year stressful life events.

Detailed demographics are reported elsewhere (Armeli et al., 2018). The current sample was 19.19 (SD =1.28) and 24.57 (SD = 1.34) years of age on average at baseline and follow-up, respectively. The sample was 53.9% female. For race/ethnicity, 86.7% identified as Caucasian, 2.4% as Black or African American, 3.1% Latinx, 7.0% were Asian or Pacific Islander, .1% were Native American or Alaskan, and .8% reported other. Participants who completed the baseline visit (N=1818) and those included in the analytic sample (N=917) did not differ on age (t = 1.39, p> .05) or sex (χ^2 = 2.81, p >.05). However, those who were included at follow-up were significantly more likely to identify as Caucasian (χ^2 = 61.39, p <.001).[1]

Measures

Beck Depression Inventory-short form (BDI; Beck et al., 1988) is a 13-item self-report measure of depressive symptoms in which Participants select statements that best describe how they have been feeling over the past week (e.g., "I do not feel sad," "I feel sad much of the time," etc.). In the current sample, the internal consistency was .85 at baseline and .88 at follow-up.

PTSD Checklist – Civilian Version (PCL-C; Weathers et al., 1993) is a 17-item self-report measure of PTSD symptoms experienced within the past month. Participants are asked to indicate how often they have been bothered by a particular symptom on a 5-point scale (1= Not at all to 5 = Extremely). Item content is based upon DSM-IV PTSD symptoms. The internal consistency was .93 at baseline and .92 at follow-up.

State Trait Anxiety Inventory Trait Scale (STAI; Spielberger, 1983) is a 20-item self-report form examining ones general feelings of anxiety. Participants are asked to indicate how well items generally describe themselves using a 7-point Likert scale (1= Strongly Disagree to 7= Strongly Agree). Example item content includes questions about ruminative thoughts and feeling uneasy. The internal consistency was .89 at baseline and .90 at follow-up.

Alcohol use was measured by asking participants to report the number of days on which they drank at least one alcoholic beverage during the 30 days prior to the assessment.

The revised NEO Personality Inventory (Costa Jr & McCrae, 2008) is a measure of "Big Five" personality traits. In the current analysis, the 12-item neuroticism and extraversion scales were used. Participants were asked to rate whether statements described themselves on a 7-point scale (1= Strongly Disagree to 7 = Strongly Agree). The internal consistencies were .85 and .64 at baseline and .88 and .67 at follow-up, for neuroticism and extraversion, respectively.

UCLA Life Stress Interview (LSI; e.g., Hammen et al., 1985) assesses episodic events and chronic stressors over a 12 month period. This study focused on episodic events. The LSI is based on the contextual threat model where an interviewer collects information about the context in which an event occurs (including life circumstances, consequences, and resources for handling the event), and then relays a description of the event in context to a team

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[1] All effects remained significant in our mediation model when ethnic/minority status was used as a covariate.

of raters blind to the participant's subjective reactions to the event. The purpose of this approach is to obtain an objective rating of the event's severity/impact without the influence of the participant's affective reactions. The team evaluates each event according to its severity on a 5-point scale (half-point ratings were allowed; 1 'No stress or Entirely Positive' to 5 'Very Severe Impact'). The rating team also indicated the degree to which the event's occurrence was dependent upon the participant on a 5-point scale (1 'Almost Completely Independent of Person' to 5 'Almost Entirely Dependent on Person'). Reliability was based on 447 randomly chosen events, rated by two coding teams; intra-class correlation (ICC) was .73 for severity and .86 for interdependence. Event content was categorized as either interpersonal- or achievement-related. We created 4 event sums, interpersonal-dependent events, interpersonal-independent events, achievement-dependent events, and achievement-independent events. Events were included if severity was of a mild impact or higher (2). Using the dependency ratings, an event was independent if coded as a 1 or 2, whereas an event was counted as dependent if coded as a 3, 4, or 5. Ambiguous events (code 3) were counted as dependent since the participant was at least partially involved.

Data Analytic Plan

We first examined bivariate associations among the major study variables, allowing for examination of stability from college (wave 1) to post college (wave 2) as well as unadjusted bivariate predictive relationships (e.g., wave 1 depression predicting interpersonal-dependent events). To examine unique stress generation effects, we conducted multiple regression analyses with each internalizing symptom domain, neuroticism, extraversion, and alcohol use as simultaneous predictors of the four types of stressful life events. In supplementary analyses, we conducted mediation analyses in which each of the four types of stressful life events were examined as mediators of the association between each individual trait and symptom variable from wave 1 to 2 (see Table S1-S4 and Figure S1).

For our primary model, we created a composite measure of internalizing symptoms by taking an aggregate of the z-scores of the BDI, PCL, and STAI. We then conducted a mediation analysis to examine the effect of wave 1 variables (internalizing symptoms, traits, and past 30-day alcohol use) on generating stressful life events and whether stressful life events were a mediator of the continuity of symptoms, traits, and alcohol use over time (e.g., events mediated the association of time 1 symptoms on time 2 symptoms). In the mediation models, all wave 2 outcomes were predicted by each of the four stressful life events and all wave 1 variables. As an example of this mediation, the "a path" was represented by the effect of internalizing symptoms at wave 1 on interpersonal-dependent events, the "b path" was the effect of interpersonal-dependent events on internalizing symptoms at wave 2, and the "c' path" represents the path from internalizing symptoms at wave 1 to internalizing symptoms at wave 2. Analyses were conducted in Mplus version 8.3 (Muthén & Muthén, 2017).[2] Models were estimated using full maximum likelihood. Missing data were estimated for all models. Estimating missing data was appropriate as 82.9% of the sample were not missing any measures and only 5 participants were missing data on 2

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[2]We conducted additional models to examine how the results may have changed if we used all 1142 participants that were invited, but did not participate at follow-up. Using either a saturated FIML model or multiple imputation, we observed the same pattern of results as obtained from the sample of 917 who participated at follow-up.

measures (no participants were missing data on 3 measures). Most missing data were due to the inclusion of STAI part way through baseline; missingness was not due to participant characteristics. Mediation models were bootstrapped 10,000 times. Bootstrapping was used in order to produce asymmetric confidence intervals that are considered an unbiased test of indirect (mediated) effects (MacKinnon et al., 2013). The mediation effects were considered significant if the 95% asymmetric confidence interval excluded zero. The magnitude of the indirect effect of stressful life events on outcomes was determined by dividing the indirect pathway (a x b) by the total effect (the product of a and b plus c'). Lastly, we tested for differences between men and women. We did this in two ways, first by examining multi-group path models and using the Wald test to compare whether the relevant paths differed by sex and second, by examining interactions with sex in separate regression models. While the study was not pre-registered, we have made our data available via the Center for Open Science (https://osf.io/93gu5/?view_only=3f1b855d3e6b4b4da3ee9c435163f978).

Results

Table 1 includes the descriptive statistics, cross-sectional, and longitudinal correlations among the study variables. At baseline, depression, PTSD, and anxiety symptoms were significantly correlated. Similarly, depression, PTSD, and anxiety were positively correlated with neuroticism and inversely correlated with extraversion. These symptoms were not correlated with alcohol use. Alcohol use was positively associated with extraversion. Neuroticism and extraversion were inversely correlated. Similar cross-sectional relationships emerged at the five-year follow-up, except alcohol was no longer associated with extraversion. We also observed significant correlations among stressful life event types. Interpersonal-dependent events were associated with interpersonal-independent events and achievement-dependent events. Interpersonal-independent events were correlated with achievement-independent events.

Each of the study's primary variables exhibited significant stability from wave 1 to the wave 2 follow up. Additionally, wave 1 depression, PTSD, and anxiety symptoms predicted wave 2 neuroticism, extraversion, and interpersonal-dependent events. Wave 1 PTSD also predicted achievement-dependent events and wave 1 anxiety predicted interpersonal-independent events. Neuroticism at wave 1 predicted wave 2 depression, PTSD, and anxiety symptoms, extraversion, and the interpersonal-dependent events. Extraversion at wave 1 inversely predicted depression, PTSD, and anxiety symptoms, and neuroticism at wave 2. Stressful life events occurring in the year prior to the follow-up also exhibited significant effects. Interpersonal-dependent events predicted symptoms of depression, PTSD, anxiety, and neuroticism at wave 2. Interpersonal-independent events predicted all three symptom measures and neuroticism at wave 2 and inversely predicted extraversion. Achievement-independent events were significantly associated with depression at wave 2. Achievement-dependent events were significantly associated with PTSD and inversely associated with extraversion at wave 2.

Symptoms, personality, and alcohol use as unique predictors of life events

We next conducted four multiple regressions, one for each type of stressful life event, to examine the specificity of stress generation (Table 2). The only unique effect that emerged across all four models was PTSD at wave 1 predicting achievement-dependent events. However, the R^2 for the interpersonal-dependent events model was significant suggesting that the combination of all baseline variables predicted interpersonal-dependent events.

Stress generation by internalizing symptoms

Given the high correlation among symptoms and literature linking these conditions, we examined an internalizing symptom composite score. With this composite measure we conducted a mediation model, designed to more stringently test stress generation along with traits and alcohol use (Figure 1). In this model, the internalizing symptom composite and all other baseline variables were predictors of each of the four types of stressful life events. In turn, each of the four different types of stressful events and all wave 1 variables were predictors of each outcome variable at wave 2. As can be seen in Figure 1, each of the wave 1 variables exhibited significant stability (even when the other three wave 1 variables and the four types of stressful life events were included as predictors). Additionally, baseline neuroticism predicted internalizing symptoms at follow-up and internalizing symptoms at baseline predicted neuroticism at follow-up. Stressful life events predicted some outcome variables. Specifically, interpersonal-dependent events predicted internalizing symptoms, whereas interpersonal-independent events predicted internalizing symptoms and neuroticism and inversely predicted extraversion.

With regard to stress generation, when baseline internalizing symptoms, alcohol use, neuroticism, and extraversion were entered as simultaneous predictors of stressful life events, only internalizing symptoms predicted interpersonal-dependent events. As a result, we examined the indirect effect of interpersonal events on internalizing symptoms from baseline to follow-up. The standardized indirect effect was .013 (SE .008, Z=1.79); the asymmetric CI did not include zero (95% CI = .003, .033). The proportion of the total effect accounted for the by the indirect pathway represents 3.57% of the total effect of internalizing symptoms from wave 1 to wave 2.

Sex Differences in Internalizing Stress Generation

We examined multi-group analyses for men and women. Wald tests of parameter equivalence indicated that stress generation pathways did not differ for men and women, such that the wave 1 internalizing to interpersonal-dependent events path and the interpersonal-dependent events to wave 2 symptoms path did not differ by sex. Separately, we examined whether sex interacted with wave 1 internalizing symptoms to predict interpersonal dependent events and this was non-significant. Similarly, an interaction between sex and interpersonal dependent events was a non-significant predictor of internalizing symptoms at wave 2.

Discussion

The stress generation hypothesis has contributed to the development of a theoretically rich model of the persistence, recurrence, and exacerbation of depression. We sought to extend the stress generation model by considering several forms of internalizing symptoms, personality traits, and alcohol use. Although we observed relatively small effect sizes, our results supported stress generation as applicable to internalizing symptoms, rather than depressive symptoms alone. In particular, we found evidence that interpersonal and behaviorally dependent stressful life events were predicted by internalizing symptoms. Additionally, we observed evidence for the full stress generation model as internalizing symptoms predicted stressful life events, which were in turn associated with symptoms. Lastly, our effects were not sex specific.

Our findings were mostly consistent with Conway et al. (2012) as we found depression, anxiety, and PTSD symptoms all predicted interpersonal-dependent events and the effect sizes were nearly identical for each symptom type. Furthermore, our regression analysis examining interpersonal-dependent events did not support a unique effect for any particular symptom domain over another. Nevertheless, there was some evidence of unique effects as only PTSD predicted achievement-dependent events in bivariate and multiple regression analyses. In many ways the small effect sizes were to be expected given the long follow-up interval as it is possible symptoms are most likely to generate events that are proximal in time. Had we used a shorter follow-up period we may have observed larger stress generation effects that are more comparable in size to what has been observed in prior research (Conway et al., 2012). Alternatively, our smaller effects might be as a result of our models being conservative due to the inclusion of many covariates. Nevertheless, our findings imply that stress generation characterizes internalizing symptoms broadly.

Findings from our mediation model further supported the notion that internalizing symptoms are characterized by stress generation as interpersonal-dependent events were found to mediate internalizing symptoms over time, even in a very conservative model that included neuroticism, extraversion, alcohol use, and other types of stressful life events as covariates. This finding supports a transactional model or a full account of stress generation model that describes how individuals with symptoms generate additional stressful life events, which in turn leads to maintenance or worsening of symptoms (Hammen, 1991). Support for this full model of stress generation has been found for depression (Goldstein et al., 2019; Holahan et al., 2005), but has not been demonstrated previously for internalizing symptoms more broadly. A second notable finding from this model is that internalizing symptoms predicted interpersonal-dependent events, but neuroticism did not. While some previous studies have found that neuroticism predicts stressful events independent of depression (Kercher et al., 2009; Uliaszek et al., 2012) or PTSD (Sadeh et al., 2015), the results of this sample and others (Goldstein et al., 2019) have found that neuroticism does not predict stressful life events when accounting for depression. It is possible that prior work finding neuroticism as a separate pathway toward generating stressful life events is a result of focusing on only a single domain of internalizing symptoms like depression or PTSD, rather than a broad measure of internalizing symptoms. Additional research may help clarifying these discrepancies.

We failed to observe stress generation effects for alcohol use. This is at odds with findings that stressful life events often result from alcohol use (Collins et al., 2007; French et al., 2011). Our follow-up period may have been too long to observe events linked with college drinking, which may be short term (e.g., break-ups, poor grades) and unfolded during college or soon after. Had we assessed drinking closer to the life stress assessment, we might have observed effects. Additionally, we may not have observed effects because we measured alcohol use with a single item that inquired about past 30 day drinking frequency and while this assessment approach is common in alcohol use research, we might have obtained different results had we used symptoms or diagnoses of alcohol use disorder. Future studies would benefit from more comprehensive measures of alcohol use.

Several additional findings from the mediation model were noteworthy. For instance, interpersonal-independent events predicted internalizing symptoms, neuroticism, and extraversion. Independent events have been found to predict depression (Kendler & Gardner, 2010). Additionally, stressful life events can influence neuroticism (Jeronimus et al., 2013) and some evidence finds extraversion can be similarly influenced by events (Vaidya et al., 2002).

Although our main focus was stress generation, we also observed significant cross-lagged paths of wave 1 neuroticism predicting wave 2 internalizing and wave 1 internalizing symptoms predicting wave 2 neuroticism. The former effect is consistent with a large literature where neuroticism predicts internalizing symptoms (e.g., Goldstein et al., 2018; Hakulinen et al., 2015).

This study has several strengths. In particular, the integration of multiple symptom measures and personality traits are rare in the literature. Furthermore, our study is perhaps the first to include alcohol use along with these other variables. Additionally, the longitudinal design allowed for testing the meditation analytic model specified in stress generation theory. We also used an interview-based assessment of stress that takes the methodologically recommended objective approach to measuring events. Lastly, the sample is quite large for this literature.

Limitations and Future Research

Nevertheless, the study has several limitations. First, our sample was relatively healthy and effects may not generalize to more symptomatic samples. Similarly, our selection for moderate college drinkers may affect generalizability, although our sample is quite similar to other college samples. Second, we used self-reports of symptoms and alcohol use rather than diagnoses. However, diagnostic categories may be viewed as inferior, as mental health problems are dimensional in nature (Kotov et al., 2017). Nevertheless, symptom measures may best reflect transitory levels of pathology that do not persist over time, limiting predictive value. Third, we did not include multiple life events measures to cover the full follow-up period (we assessed events during the year prior to the 5 year follow-up). Similarly, we may be underestimating the stress generation effect which may be observed variably over different time scales (e.g., alcohol use may predict events, but only in the short term). Fourth, we did not include other known mediators of stress generation such as cognitive style or attachment. Fifth, we did not include a comparable measure of stressful

life events at baseline, which would have been useful to control for the possibility of continuity of stressful experiences. Sixth, our stressful life events measure occurred at the same time as our symptom, personality, and alcohol use follow-up assessment. Data that are assessed cross-sectionally are not ideal for testing indirect effects (Maxwell et al., 2011). However, it is important to note that although the follow-up stress and symptom measures occurred cross-sectionally, the study is still longitudinal as the initial assessment clearly precedes the stressful life event and follow-up assessment. Additionally, it is critical to acknowledge the differences in the timing intervals covered by the stressful life event measures vs. the symptom measures at follow-up. As the stressful life events assessment covered the 12 months prior to the follow-up, whereas the follow-up symptom measures assessed a short period of time (the two-four past weeks). In other words, the stressful life and symptom assessments had very little overlap with regard to the timeframes they measured. Therefore, even though temporal separation was not achieved by having stressful life events assessed at a different time point, the use of a life event interview that covered a longer time interval partially achieves a separation between the occurrence of life events and symptoms at follow-up.

Lastly, we used the trait version of the STAI. Although, the STAI state version has been used in prior stress generation research (Hankin et al., 2005), the use of the trait version is problematic for several reasons. The trait component of the STAI may be more akin to personality and could mimic trait neuroticism rather anxiety symptoms. Thus, our lack of findings for the STAI, may be due to shared variance with neuroticism. Additionally, the trait component of the STAI does not assess the same time frame as the other symptom measures we included (past week and past month symptoms for BDI and PCL, respectively). As a result, it is possible that more direct measures of anxiety symptoms will demonstrate stress generation.

Conclusion

Overall, this study contributes to the literature in several ways. Specifically, we observed that internalizing symptoms in the aggregate may better capture the stress generation effect rather than depression alone. Moreover, our analyses provided support for the full stress generation model as internalizing symptoms predicted interpersonal events, which in turn predicted symptoms. Additionally, there are conflicting findings regarding the role of neuroticism in stress generation, and our results have added further evidence that stress generation may in fact be specific to symptoms, and that any observed effect of neuroticism on generating stress is due to shared variance with symptoms that may go undetected in studies that do not include broad measurement coverage of internalizing symptoms. The stress generation model continues to enrich research on psychopathology, and our results highlight that many questions remain to be explored in this area. Future work that integrates several predictors of stress will help refine etiological and developmental theories of mental health problems.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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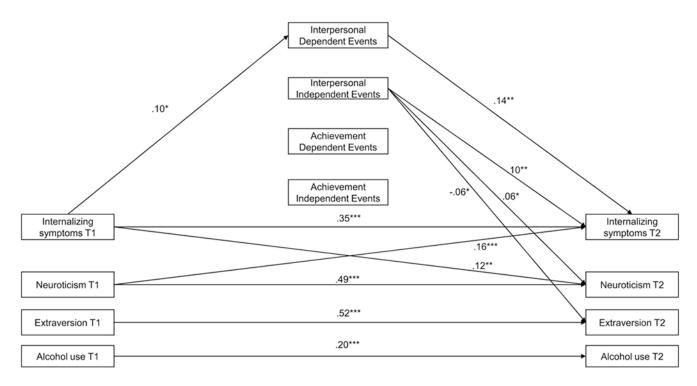
Figure 1. Internalizing symptoms, alcohol use, personality traits, and the indirect effect of stressful life events.

Note. For simplicity several paths have been removed. Non-significant longitudinal pathways are not depicted. Additionally, significant and non-significant cross-sectional covariances at T1 and T2 are not shown. The result is that only significant pathways relevant to study hypotheses or significant predictive pathways are shown. All pathways are standardized coefficients. N=917.

Table 1.

Descriptive statistics and bivariate correlations at baseline and follow-up

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Depression T1	-	.64***	.63***	~.00	.58***	-.30***	.43***	.37***	.34***	~.00	.38***	-.22***	.12***	.06	.03	.04
2. PTSD T1		-	.61***	.05	.55***	-.24***	.35***	.42***	.32***	.01	.37***	-.20***	.13***	.06	.08*	.02
3. Anxiety T1			-	.01	.72***	-.31***	.35***	.31***	.43***	.05	.48***	-.24***	.12***	.07*	.01	-.01
4. Alcohol use T1				-	-.04	.08*	-.03	.01	~.00	.20***	-.03	.09*	~.00	.03	.03	.003
5. Neuroticism T1					-	-.37***	-.37***	.36***	.38***	.01	.57***	-.28***	.13***	.06	.02	-.01
6. Extraversion T1						-	-.19***	-.14***	.16***	-.03	-.21***	.56***	-.03	-.03	.04	-.05
7. Depression T2							-	.62***	.69***	.02	.62***	-.34***	.14***	.14***	.02	.09**
8. PTSD T2								-	.59***	-.02	.56***	-.19***	.22***	.14***	.08*	.04
9. Anxiety T2									-	.05	.75***	-.31***	.20***	.13***	.04	.08*
10. Alcohol use T2										-	.01	.01	~.00	-.01	-.02	.01
11. Neuroticism T2											-	-.36***	.14***	.10**	.05	.02
12. Extraversion T2												-	-.04	-.09**	-.01	-.09**
13. Int.-dependent													-	.09**	.18**	.02
14. Int.-independent														-	.03	.13***
15. Ach.-dependent															-	-.05
16. Ach.-independent																-
M	3.95	29.03	36.95	7.24	40.52	58.08	3.42	26.16	37.54	8.55	40.73	56.41	.35	.17	.26	.08
SD	4.37	11.55	9.46	4.08	12.33	7.52	4.26	9.82	9.84	6.30	12.83	7.80	.69	.48	.52	.31
n	915	917	767	917	912	912	917	916	916	917	914	914	917	917	917	917

Note. Symptoms and personality are raw scores and stressful life events are counts. Alcohol use is defined as the number of days in which a participant drank out of the past 30 days.

Correlations that are near zero are noted as ~.00.

*
= p<.05

**
= p<.01

***
= p<.001; Full Sample N=917.

Table 2.

Specificity of stress generation

T1 Predictor	Interpersonal						Achievement					
	Dependent Events			Independent Events			Dependent Events			Independent Events		
	B	b	t	B	b	t	B	b	t	B	b	t
Depression	.04	.01	.81	.02	.002	.41	.01	.001	.14	.07	.01	1.42
PTSD	.07	.004	1.51	.02	.001	.37	.13*	.01	2.51	.02	.001	.55
Anxiety	−.001	.000	−.02	.05	.002	.67	−.10	−.01	−1.62	−.05	−.002	−.91
Alcohol use	−.003	.000	−.07	.03	.003	.76	.02	.003	.62	.004	.000	.01
Neuroticism	.08	.004	1.48	.00	.00	.00	.03	.001	.65	−.05	−.001	−.99
Extraversion	.03	.002	.74	−.01	.00	−.21	.05	.003	1.33	−.06	−.002	−1.33
Model R^2	.023*			.006			.015			.007		

Note. B are standardized estimates, *b* are unstandardized estimates

*
= $p < .05$