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Stable "Trait" Variance of Temperament as a Predictor of the Temporal Course of Depression and Social Phobia

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A large body of research has found robust associations between dimensions of temperament (e.g., neuroticism, extraversion) and the mood and anxiety disorders. However, mood-state distortion (i.e., the tendency for current mood state to bias ratings of temperament) likely confounds these associations, rendering their interpretation and validity unclear. This issue is of particular relevance to clinical populations who experience elevated levels of general distress. The current study used the "trait–state-occasion" latent variable model (D. A. Cole, N. C. Martin, & J. H. Steiger, 2005) to separate the stable components of temperament from transient, situational influences such as current mood state. We examined the predictive power of the time-invariant components of temperament on the course of depression and social phobia in a large, treatment-seeking sample with mood and/or anxiety disorders (N = 826). Participants were assessed 3 times over the course of 1 year, using interview and self-report measures; most participants received treatment during this time. Results indicated that both neuroticism/behavioral inhibition (N/BI) and behavioral activation/positive affect (BA/P) consisted largely of stable, time-invariant variance (57% to 78% of total variance). Furthermore, the time-invariant components of N/BI and BA/P were uniquely and incrementally predictive of change in depression and social phobia, adjusting for initial symptom levels. These results suggest that the removal of state variance bolsters the effect of temperament on psychopathology among clinically distressed individuals. Implications for temperament–psychopathology models, psychopathology assessment, and the stability of traits are discussed.

Keywords: depression, social anxiety, temperament, mood-state distortion, trait-state models

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Over the past 30 years, a large body of research has focused on understanding how personality traits and related temperaments are associated with the mood and anxiety disorders. This work has been of particular interest in elucidating the etiologies and high rates of comorbidity among these disorders, given that traits have a large heritable component, are relatively stable over time, and share substantial genetic and phenotypic variance with the mood and anxiety disorders (e.g., Bienvenu, Hettema, Neale, Prescott, & Kendler, 2007; Hettema, Neale, Myers, Prescott, & Kendler, 2006; Krueger, McGue, & Iacono, 2001). Most research has focused on two broad traits: neuroticism (i.e., a tendency toward negative emotions and stress reactivity) and extraversion (i.e., sociability, assertiveness, a tendency toward positive emotions). Neuroticism and extraversion are closely tied to the temperaments of negative affectivity and positive affectivity, respectively, and are linked to Gray's behavioral inhibition and behavioral activation systems that motivate withdrawal and approach behavior (e.g., Carver & White, 1994; Clark, Watson, & Mineka, 1994). A recent meta-analysis found that nearly all of the mood and anxiety disorders are characterized by elevated levels of neuroticism and lower levels of extraversion (Kotov, Gámez, Schmidt, & Watson, 2010).

Although both neuroticism/negative affectivity and extraversion/positive affectivity are associated with the mood and anxiety disorders, they vary across disorders with regard to the magnitude of these associations. Neuroticism/negative affectivity consistently demonstrates a moderate to strong relation with most of the mood and anxiety disorders, with levels typically highest in depression and generalized anxiety disorder (GAD). Low levels of extraversion/positive affectivity typically are most marked in depression and social phobia (e.g., T. A. Brown, 2007; T. A. Brown, Chorpita, & Barlow, 1998; Mineka, Watson, & Clark, 1998; Watson, Gámez, & Simms, 2005), although the Kotov et al. (2010) meta-analysis found similarly low levels in other anxiety disorders.[1] It appears that the positive affectivity component of extraversion is

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[1] It is unclear why low extraversion/positive affectivity was relatively specific to depression and social phobia in numerous studies, but was associated with multiple mood and anxiety disorders in the Kotov et al. (2010) meta-analysis. This discrepancy may be due in part to the assessment of psychopathology via diagnostic groups with comorbidity in the meta-analysis, as well as using extraversion but not related positive affectivity measures that may show greater specificity to certain disorders (e.g., depression).

largely responsible for the association between depression and extraversion, whereas social phobia is more strongly and broadly associated with extraversion (Naragon-Gainey, Watson, & Markon, 2009). Researchers have also examined the associations between temperament and the course of mood and anxiety disorders in clinical samples, wherein most studies focused on treatment outcomes among those with depression. Several studies found that temperament levels were predictive of disorder course, such that higher levels of neuroticism/negative affectivity and lower levels of extraversion/positive affectivity predicted poorer outcome (e.g., T. A. Brown, 2007; Geerts & Bouhuys, 1998; Joyce, Mulder, & Cloninger, 1994; Kasch, Rottenberg, Arnow, & Gotlib, 2002). However, others did not find significant effects of temperament on the course of disorders (e.g., Boyce & Parker, 1985; Clark, Vittengl, Kraft, & Jarrett, 2003; Sato et al., 1999).

One persistent methodological issue in this literature that may have contributed to the above inconsistencies is that the assessment of temperament and personality is influenced by both stable "trait" variance (typically the target of assessment) and transient "state" effects (e.g., current mood, situational influences). In clinical samples, the general distress associated with the experience of a psychological disorder is likely to influence the report of affect-laden traits like neuroticism/negative affectivity and extraversion/positive affectivity (e.g., T. A. Brown, 2007; Clark et al., 2003; Widiger & Smith, 2008). This phenomenon, known as *mood-state distortion*, would result in biased estimates of the associations between traits and disorders. This issue is further complicated by the fact that traits are not immutable and theoretically should change somewhat during the remittance or development of a psychological disorder (Clark et al., 2003; Costa, Bagby, Herbst, & McCrae, 2005). Thus, true change in traits and the influence of a transient current mood state cannot be easily disentangled.

Some researchers have attempted to assess and minimize the impact of mood-state distortion when examining trait–psychopathology associations, focusing primarily on the mood disorders. Merz and Roesch (2011) used multilevel factor analysis in a 5-day experience sampling study with college students to examine the associations of (a) daily state and trait positive and negative affect with (b) depression and anxiety symptoms measured at follow-up. Trait and state negative affect were significantly associated with depression and anxiety, whereas state (but not trait) positive affect was associated with both symptoms. However, this study was limited by the use of a nonclinical sample and assessment of symptoms at a single time point, precluding an examination of the associations between symptom change and traits.

Consistent with prior studies (e.g., Duggan, Sham, Lee, & Murray, 1991; Hirschfeld, Klerman, Clayton, & Keller, 1983; Hirschfeld, Klerman, Clayton, Keller, McDonald-Scott, & Larkin, 1983), Santor, Bagby, and Joffe (1997) found significant changes in neuroticism and extraversion over 5 weeks of pharmacotherapy among a group of depressed outpatients. However, change in depression symptoms only modestly accounted for change in traits (R^2 = 12% for neuroticism and 5% for extraversion), suggesting minimal impact of current mood state on personality. Building on this finding, Clark and colleagues (2003) used factor analytic and regression techniques to distinguish state and trait variance in negative and positive affect in a sample of depressed patients receiving cognitive therapy. Although depression symptoms were correlated with both trait and state variance in the temperament measures, change in depression symptoms was strongly correlated with change in an aggregated affective state component of temperament (r = .58), but weakly or nonsignificantly correlated with the stable variance of most of the traits (rs = |.02| to |.23|). Thus, these results support the contention that although depressed mood impacts ratings of temperament, stable variance can be identified that is relatively independent of fluctuating mood states.

T. A. Brown (2007) examined changes in depression, social phobia, and GAD over the course of 2 years in a clinical sample of outpatients (about 75% received treatment during this period). Symptom severity (as assessed by self-report measures and interview) and two temperaments (referred to as neuroticism/behavioral inhibition or N/BI, and behavioral activation/positive affect or BA/P) were assessed on three occasions. Brown found that BA/P was quite stable over this period (Cohen's d = 0.19), whereas N/BI declined substantially (Cohen's d = 0.70), and results suggested that the impact of mood-state distortion was most pronounced at lower levels of N/BI. In parallel-process latent growth models holding initial disorder severity constant (thereby accounting for some of the "general distress" associated with mood-state distortion), higher initials levels of N/BI were associated with less reduction in symptoms of social phobia and GAD. In addition, lower initial levels of BA/P predicted less improvement in social phobia symptoms (standardized path = .18, $p <$ .01), although this effect was no longer significant after partialing N/BI (standardized path = .13, p = .07). However, contrary to hypotheses, N/BI and BA/P were not significantly related to change in depression, after adjusting for initial depression levels. Brown noted that because depression may have a particularly large component of general distress in clinical samples, it is plausible that mood-state distortion masked the expected associations between depression and temperament by restricting the amount of unique predictive variance for each.

The methodologies and analytical approaches of the above studies help elucidate the impact of mood-state distortion on trait–psychopathology associations, but none provide direct estimates of transient state variance and stable trait variance for each temperament/personality trait. The approach used by Clark et al. (2003) yielded a single affective state estimate drawn from multiple traits. This strategy was appropriate for examining the effect of overall mood in their homogeneous depressed sample, but would be less suitable for a heterogeneous diagnostic group or for examining differential state effects of negative affect versus positive affect.

The trait–state-occasion (TSO) latent variable model, developed by David Cole and colleagues, provides a flexible statistical tool for parsing stable versus transient sources of variance using repeated assessments of a construct (Cole, Martin, & Steiger, 2005; see Duncan-Jones, Fergusson, Ormel, & Horwood, 1990, and Ormel & Schaufeli, 1991, for the development of similar models). The TSO model, formulated within the structural equation modeling framework, is built from multiple indicators (i.e., two or more) of a construct assessed at three or more time points. The latent variables formed from these indicators are referred to as *state* factors and represent the total observed variance for the construct as measured at a particular point in time. The variance for the state factors is then completely distributed into two sources: (1) a *trait* factor, on which all state factors load at unity, and (2) *occasion* factors that are defined by

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each state factor (again, loading at unity). In this way, the trait factor represents the time-invariant, stable component shared across assessment points, whereas the occasion factors represent transient, time-variant components for each assessment (e.g., current mood state) not accounted for by the trait component. In addition, the occasion factors are autoregressive, with paths between subsequent time points (e.g., from Time 1 to Time 2) that model stability of situational influences (see Figure 1 for a schematic example of the TSO model). Given that autoregressive longitudinal models differ in their labeling and usage of these variance components (particularly *state* and *occasion*), we refer to the stable trait component as *time-invariant* and the transient occasion component as *time-variant*.

The current study is the first to use the TSO model to quantify and model the time-invariant components and the time-variant components (influenced by general distress and other situational factors) of temperaments in the prediction of the temporal course of disorders, thereby accounting for the effects of mood-state distortion. A definitive quality of traits is that they are relatively enduring (e.g., Funder, 1991; Roberts, 2009; Tellegen, 1991), and transient state components of temperament that may be associated with psychiatric distress are typically viewed as obscuring the stable variance of interest (e.g., Santor et al., 1997). Thus, parsing this variance is important to most accurately ascertain the "true" associations of traits with the mood and anxiety disorders (i.e., associations with the stable portion of traits), and to what extent traits are informative above and beyond general distress and current mood. To this end, we predicted the course of disorders from the time-invariant component of temperament in the current study. Neuroticism/negative affectivity and extraversion/positive affectivity were assessed in a large and diagnostically diverse sample of treatment-seeking outpatients, measured at three time points over the course of 1 year. Here, we label the temperaments *neuroticism/behavioral inhibition* (N/BI) and *behavioral activation/positive affect* (BA/P) to reflect the marker indicators used in this study and to be consistent with T. A. Brown (2007). We examined N/BI and BA/P in relation to depression and social phobia, two common disorders that have been consistently linked to the above temperaments (e.g., T. A. Brown, 2007; Naragon-Gainey et al., 2009; Watson et al., 2005).

Using latent growth models (LGMs) to quantify change in these disorders over time and holding initial disorder severity constant,[2] we hypothesized that (1) in single-process models (i.e., models with one temperament and one disorder), the time-invariant components of N/BI and BA/P each would be significantly associated with change in depression and social phobia symptoms. Specifically, we expected that higher levels of N/BI would be associated with less symptom reduction over time, whereas higher levels of BA/P would be associated with greater symptom reduction over time. Such findings would be consistent with several prior longitudinal studies (e.g., T. A. Brown, 2007; Geerts & Bouhuys, 1998; Joyce et al., 1994; Kasch et al., 2002), but would extend these results by accounting for mood-state distortion, and (2) these associations would remain significant in parallel-process models that include one of the disorders and both temperaments simultaneously (accounting for shared variance between N/BI and BA/P), and both disorders and both temperaments simultaneously (accounting for comorbidity and shared temperament variance).

Method

Participants and Procedure

The sample consisted of 826 adults who presented for assessment and/or treatment at the Center for Anxiety and Related Disorders at Boston University.[3] The majority of the sample was female (60.4%) and the average age was 33.6 years old (SD = 12.5, range = 18 to 79 years). Most participants identified as Caucasian (86.3%), and the remaining participants identified as African American (4.0%), Asian (4.8%), Latino/Hispanic (4.5%), or other/multiple (0.4%). Nearly three quarters (74.1%) of the sample received treatment at the Center for Anxiety and Related Disorders after the intake assessment.

Participants completed self-report questionnaires measuring temperament and symptoms, as well as a clinical diagnostic interview, at three time points: baseline, 6-month follow-up, and 12-month follow-up. At baseline, current and past diagnoses were established with the Anxiety Disorders Interview Schedule for *DSM–IV*–Lifetime version (ADIS-IV-L; Di Nardo, Brown, & Barlow, 1994), a semistructured interview designed to ascertain reliable diagnosis of the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM–IV*) anxiety, mood, somatoform, and substance use disorders and to screen for the presence of other conditions (e.g., psychotic disorders). At 6- and 12-month follow-ups, patients were reevaluated using the follow-up version of the ADIS-IV, which is identical to the ADIS-IV-L except that (a) sections for past diagnoses are omitted and (b) a section is included to assess treatment follow-up (e.g., nature and extent of treatments received since intake). Both ADIS-IV versions provide dimensional assessment of the key and associated features of disorders (0–8 ratings); such features are dimensionally rated regardless of whether a formal *DSM–IV* diagnosis is under consideration. A reliability study entailing two independent administrations of the ADIS-IV-L indicated good-to-excellent interrater agreement for current disorders (range of κs = .67 to .86) except dysthymia (κ = .31; T. A. Brown, Di Nardo, Lehman, & Campbell, 2001). During the course of the current study, a subsample of 74 cases underwent two independent administrations of the ADIS-IV-L to evaluate interrater reliability (results reported below). Rates of current clinical disorders occurring frequently in the sample at baseline were as follows: social phobia (47.6%), major depressive disorder

[2] We decided LGM would be more appropriate than the TSO model for temporal modeling of the disorders for several reasons. Although theory dictates that traits should be relatively stable over time, no such assumption is made for the course of depression and social phobia, which may be acute or chronic in nature. Given that most of the current sample received treatment, we expected relatively low rates of symptom stability and wished to model total temporal change across the course of the study. In addition, modeling the disorders with LGMs is consistent with the approach of T. A. Brown (2007), thus allowing direct comparison of results between studies to draw conclusions regarding the effect of isolating the trait variance of temperament in predicting symptom change.

[3] Analyses from this sample were previously published by T. A. Brown and Rosellini (2011), focusing on life stress and depression. Because the course of depression was used as an outcome variable in both studies, the longitudinal measurement model of depression presented in Table 1 and the LGM of depression presented in Table 4 of the current study are the same as those of Brown and Rosellini, except for a linear transformation described in the note for Table 4. This sample is completely distinct from that of T. A. Brown (2007).

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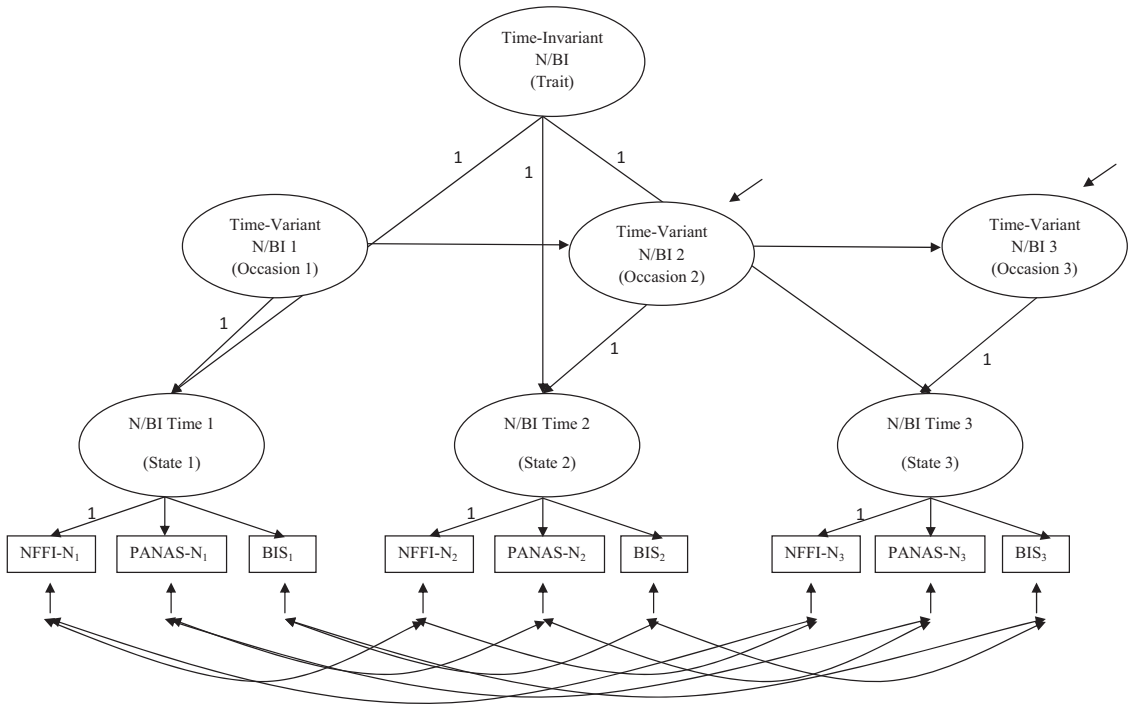

Figure 1. Trait–state-occasion model for neuroticism/behavioral inhibition. N/BI = neuroticism/behavioral inhibition; NFFI-N = Neuroticism scale of NEO Five-Factor Inventory; PANAS-N = Negative Affect scale of the Positive and Negative Affect Schedule; BIS = Behavioral Inhibition Scale. Note that the residual variances of all state factors were fixed to zero.

(30.4%), GAD (29.4%), panic disorder with or without agoraphobia (24.5%), obsessive–compulsive disorder (16.7%), specific phobia (15.4%), and dysthymic disorder (7.7%).

Measures

Multiple indicators (including self-report and interview measures) were selected for each construct, using markers similar or identical to those in T. A. Brown (2007) to facilitate comparisons. Each measure was completed at each of the three assessments, and the measure listed first for each construct was used as the marker indicator in latent variable analyses.

N/BI. The following measures were used as indicators of the latent construct of N/BI: (a) the Neuroticism scale of the NEO Five-Factor Inventory (NFFI; Costa & McCrae, 1992); (b) the Behavioral Inhibition Scale of the Behavioral Inhibition/Behavioral Activation Scales (BIS/BAS; Carver & White, 1994); and (c) the Negative Affect scale of the Positive and Negative Affect Schedule (PANAS–N, "in general" timeframe instructions; Watson, Clark, & Tellegen, 1988).

BA/P. Three scales were used as indicators of BA/P: (a) the Behavioral Activation Scale of the BIS/BAS; (b) the Positive Affect scale of the PANAS (PANAS-P); and (c) the Extraversion scale of the NFFI.

Depression. Indicators for a unipolar depression factor were as follows: (a) Depression scale of the 21-item version of the Depression Anxiety Stress Scales (DASS-D; Lovibond & Lovibond, 1995; cf. Antony, Bieling, Cox, Enns, & Swinson, 1998; T. A. Brown, Chorpita, Korotitsch, & Barlow, 1997); (b) Beck Depression Inventory (BDI; Beck & Steer, 1987); and (c) the sum of ADIS-IV dimensional ratings of the nine-symptom criteria of *DSM–IV* major depression, which ranged from 0 (*none*) to 8 (*very severe*; interrater r = .74, T. A. Brown et al., 2001). Interrater reliability in a subsample for the current study was good (intraclass correlation [ICC] = .78). In accordance with prior studies (e.g., T. A. Brown, 2007; T. A. Brown et al., 1998; T. A. Brown & Rosellini, 2011), we scored the BDI using the 10 items that load on a Cognitive/Affective factor (Items 1–9, 13) because they are more specific to the unipolar mood disorders.

Social phobia. The following measures were used to assess social phobia: (a) the Social Interaction Anxiety Scale (Mattick & Clarke, 1998; cf. E. J. Brown et al., 1997); (b) the sum of ADIS-IV dimensional ratings of the fear of 13 social situations (e.g., initiating a conversation, participating at meetings and/or classes), ranging from 0 (*no fear*) to 8 (*very severe fear*; interrater ICC for the current study = .84); and (c) the Social Phobia scale of the Albany Panic and Phobia Questionnaire (Rapee, Craske, & Barlow, 1994/1995; cf. T. A. Brown, White, & Barlow, 2005).

Data Analysis

The raw data were analyzed using a latent variable software program and maximum-likelihood minimization functions (Mplus 6.0; Muthén & Muthén, 1998–2010), and the metric of each disorder and temperament latent variable was set with marker indicators (see Table 1). Missing data due to attrition (25% at Time 2, 40% at Time 3) were accommodated in all analyses using direct maximum likelihood (cf. Allison, 2003; Raykov, 2005). Goodness

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Table 1
Completely Standardized Factor Loadings From Longitudinal Measurement Models

Measure	Factor loading			Model constraint
	Time 1	Time 2	Time 3	
Depression[a]				
DASS-D	.89	.90	.90	All λs and τs held equal
ADIS-D	.78	.82	.82	
BDI	.89	.88	.88	
Social phobia[b]				
SIAS	.91	.90	.89	All held equal except λ and τ of APPQ-S at Time 1
ADIS-S	.91	.90	.90	
APPQ-S	.87	.85	.85	
Neuroticism/behavioral inhibition[c]				
NFFI-N	.88	.91	.92	All λs held equal
PANAS-N	.76	.81	.79	
BIS	.67	.69	.67	
Behavioral activation/positive affect[d]				
BAS	.64	.63	.63	All λs held equal
PANAS-P	.78	.80	.79	
NFFI-E	.78	.81	.83	

Note. $N = 826$. Time 1 = intake; Time 2 = 6-month follow-up; Time 3 = 12-month follow-up; DASS-D = Depression scale of the Depression Anxiety Stress Scales; ADIS-D = Anxiety Disorders Interview Schedule for *DSM–IV* (ADIS-IV) ratings of major depression; BDI = Beck Depression Inventory; SIAS = Social Interaction Anxiety Scale; ADIS-S = ADIS-IV ratings of situational social fear; APPQ-S = Social Phobia scale of the Albany Panic and Phobia Questionnaire; NFFI-N = Neuroticism scale of NEO Five-Factor Inventory; PANAS-N = Negative Affect scale of the Positive and Negative Affect Schedule; BIS = Behavioral Inhibition Scale; BAS = Behavioral Activation Scale; PANAS-P = Positive Affect scale of the Positive and Negative Affect Schedule; NFFI-E = Extraversion scale of NEO Five-Factor Inventory; λ = factor loading; τ = indicator intercept. All loadings are significant at $p < .001$. The marker for each factor is the first indicator listed. Model fit as shown below are for the final longitudinal invariance models. Note that for N/BI and BA/P, invariance of indicator intercepts was not tested because the trait–state-occasion model used for these traits does not involve mean structure estimation.
[a] Model fit: $\chi^2(23) = 59.80$, $p < .001$; comparative fit index (CFI) = .99; Tucker–Lewis index (TLI) = 0.99; root mean square error of approximation (RMSEA) = 0.04; standardized root mean square residual (SRMR) = .03. [b] Model fit: $\chi^2(21) = 83.24$, $p < .001$; CFI = .99; TLI = 0.98; RMSEA = 0.06; SRMR = .02. [c] Model fit: $\chi^2(22) = 32.31$, $p > .05$; CFI = 1.00; TLI = 1.00; RMSEA = 0.02; SRMR = .05. [d] Model fit: $\chi^2(22) = 52.54$, $p < .001$; CFI = .99; TLI = 0.99; RMSEA = 0.04; SRMR = .03.

of fit of the models was evaluated using the root mean square error of approximation (RMSEA), the Tucker–Lewis index (TLI), the comparative fit index (CFI), and the standardized root mean square residual (SRMR). Acceptable model fit was defined in part by the criteria described by Hu and Bentler (1999): RMSEA values close to .06 or below, CFI and TLI values close to 0.95 or above, and SRMR values close to .08 or below. In the case of nested models (e.g., evaluation of longitudinal measurement invariance), comparative fit was evaluated with χ^2 difference tests (χ^2_{diff}). The acceptability of the models was further evaluated by the presence or absence of salient localized areas of strains in the solutions (e.g., modification indices) and the strength and interpretability of the parameter estimates.

Results

Longitudinal Measurement Models

To determine whether the data were appropriate for longitudinal latent variable modeling (i.e., the TSO model and LGMs), we assessed the constructs for measurement invariance across the three assessment points. If measurement invariance was not present, then true temporal change in the constructs would be confounded with measurement change over time. Specifically, each model must demonstrate partial or full measurement invariance, meaning that each latent variable must have at least one invariant indicator in addition to the marker indicator (cf. T. A. Brown, 2006; Byrne, Shavelson, & Muthén, 1989). Longitudinal confirmatory factor analyses were conducted separately for each disorder and temperament construct. Preliminary to conducting LGMs for the disorders, we tested for invariance of factor loadings (λs) and indicator intercepts (τs). Because the TSO model was used for temperament and this model does not involve the mean structure, only invariance of factor loadings was tested for N/BI and BA/P. The residuals of each indicator were allowed to covary across assessment points (e.g., Time 1 BDI, Time 2 BDI, and Time 3 BDI) to model measure-specific variance, and the latent variables were allowed to correlate with one another across assessment points. An unrestricted baseline model was first evaluated, followed by a model that constrained factor loadings to be equal across assessment points, and then (for depression and social phobia only) a model that constrained factor loadings and indicator intercepts to be equal across assessment points. A significant increase in χ^2 from one model to the next indicated a lack of measurement invariance.

Results from the confirmatory factor analyses are shown in Table 1. All standardized factor loadings were strong (λs = .63 to

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.91) and statistically significant ($ps < .001$), and model fit was excellent (see Table 1). The longitudinal model for depression, N/BI, and BA/P was fully measurement-invariant, whereas the social phobia model possessed partial measurement invariance (i.e., one factor loading and indicator intercept was time-invariant, in addition to the marker indicator). These tests indicated that it was acceptable to proceed with longitudinal latent variable modeling.

Table 2 shows zero-order correlations among the latent variables. As expected, latent variables of the same construct were strongly correlated across assessments, approaching unity in some cases for social phobia ($rs = .87$ to .96) and BA/P ($rs = .85$ to .90). In addition, depression was strongly associated with N/BI at each assessment ($rs = .77$ to .83). Correlations of social phobia with N/BI ($rs = .59$ to .67) and of depression and social phobia with B/PA ($rs = -.58$ to $-.66$) were more moderate in magnitude (i.e., the 95% confidence intervals were nonoverlapping with confidence intervals for depression–N/BI correlations). Intercorrelations among all of the indicators may be found in online Supplemental Table 1.

Trait–State-Occasion Models of N/BI and BA/P

Next, TSO models were evaluated for N/BI and BA/P to quantify and parse their time-variant and time-invariant components. As described by Cole and colleagues (e.g., Cole et al., 2005) and shown in Figure 1, the model was specified such that the latent temperament variables at each of the three time points (i.e., the state factors) loaded onto a time-invariant (trait) factor, with the factor loadings fixed to one. In addition, time-variant (occasion) factors were created that were defined by the corresponding latent variable from that time point, with factor loadings fixed to one (e.g., time-variant N/BI at Time 1 was defined by the N/BI latent variable at Time 1). The residual variances of the state factors were fixed to zero to distribute all variance to either time-invariant or time-variant factors. Autoregressive paths were included from the Time 1 to Time 2 time-variant factors and from the Time 2 to Time 3 time-variant factors to index successive occasion stability.

We also imposed several restrictions suggested by Cole and colleagues (2005) to improve model identification and parsimony: (a) Factor loadings were held to equality for each indicator across assessments points (consistent with the previously demonstrated longitudinal invariance for N/BI and BA/P), (b) the residual variances of the second and third time-variant factors were held to equality (the first time-variant factor is an exogenous variable and therefore has no residual variance), and (c) the autoregressive time-variant paths were constrained to equality. In addition, to account for shared method variance across time, we allowed the residual variances of each indicator to covary across assessment points, as in the longitudinal measurement models described previously. This correlated uniqueness approach was found to be appropriate for TSO models in a recent simulation study (LaGrange & Cole, 2008). Factor means were set to zero.

As shown in Table 3, both the N/BI and BA/P models fit the data well. The total (unstandardized) variance for the N/BI factors was markedly smaller at baseline (66.63) than at Times 2 or 3 (79.64 and 84.80, respectively). In contrast, the total factor variances for BA/P were nearly identical across the three assessment points (17.21, 17.38, and 17.43, respectively). Significant time-invariant and time-variant components emerged for both temperaments (ps for factor variances $< .05$), but N/BI and BA/P were primarily composed of time-invariant variance, accounting for between 57% and 78% of the total variance at each assessment. Thus, a relatively small portion of the variance in self-reported temperament was due to transitory occasion-specific influences, such as current mood state. Although the proportion of time-invariant variance was high and nearly identical across assessment points for BA/P (77% to 78%), it is noteworthy that the proportion of time-invariant variance was substantially larger for Time 1 N/BI (71%) than for the subsequent two assessment points (60% and 57%). Because the absolute size of the time-invariant component remains constant across assessment points in TSO models, differences in the proportion of time-invariant variance is a function of differences in total factor variance across assessments points. Thus, the proportion of time-invariant variance was highest at baseline for N/BI because the total factor variance was smallest at this assessment point. The autoregressive paths that index occasion stability were moderate in size and positive for both temperaments (standardized estimates = .45 to .55; $p < .01$), suggesting that

Table 2
Zero-Order Correlations Among Latent Diagnostic and Statistical Manual of Mental Disorders *(4th ed.) Disorder and Temperament Constructs*

Construct	DEP1	DEP2	DEP3	SOC1	SOC2	SOC3	N/BI1	N/BI2	N/BI3	BA/P1	BA/P2
DEP2	.70										
DEP3	.66	.84									
SOC1	.41	.37	.39								
SOC2	.43	.57	.55	.88							
SOC3	.39	.54	.58	.87	.96						
N/BI1	.77	.58	.56	.59	.55	.52					
N/BI2	.62	.79	.69	.46	.65	.56	.76				
N/BI3	.60	.71	.83	.48	.63	.67	.76	.87			
BA/P1	−.58	−.53	−.47	−.64	−.60	−.58	−.55	−.48	−.44		
BA/P2	−.52	−.66	−.55	−.56	−.66	−.53	−.49	−.61	−.54	.90	
BA/P3	−.46	−.61	−.61	−.55	−.61	−.65	−.48	−.55	−.60	.85	.90

Note. $N = 826$. All correlations are significant at $p < .001$. DEP = depression; SOC = social phobia; N/BI = neuroticism/behavioral inhibition; BA/P = behavioral activation/positive affect. Numbers following each construct label indicate assessment point: Intake = 1, 6-month follow-up = 2, 12-month follow-up = 3.

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Table 3
Estimates for Trait–State-Occasion Models of Temperament Constructs

Measure	N/BI[a]			BA/P[b]		
	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3
Total variance (unstandardized)	66.63***	79.64***	84.80***	17.21***	17.38***	17.43***
Time-invariant factor variance (unstandardized)	47.43***	47.43***	47.43***	13.50***	13.50***	13.50***
Time-variant factor variance (unstandardized)	18.93***	31.38***	35.62***	3.71*	3.89**	3.93**
Proportion of variance due to time-invariant component	.71	.60	.57	.78	.78	.77
Proportion of variance due to time-variant component	.29	.40	.43	.22	.22	.23
Stability coefficient (standardized)	—	.45***	.55***	—	.54**	.55**

Note. $n = 818$ (8 participants from the full sample did not complete any of the temperament scales and were excluded from these analyses). Time 1 = baseline; Time 2 = 6-month follow-up; Time 3 = 12-month follow-up; N/BI = neuroticism/behavioral inhibition; BA/P = behavioral activation/positive affect. Note that the proportions of variance due to the time-variant components can be further decomposed into autoregressive (stable) variance and time-variant (residual) variance for Time 2 and Time 3. Specifically, the proportion of autoregressive variance is equal to the squared stability coefficient at a given time point, and the proportion of residual variance is equal to the proportion of variance due to the time-variant component minus the squared stability coefficient.
[a] Model fit: $\chi^2(27) = 52.86$, $p < .01$; comparative fit index (CFI) = .99; Tucker–Lewis index (TLI) = 0.99; root mean square error of approximation (RMSEA) = 0.03; standardized root mean square residual (SRMR) = .08. [b] Model fit: $\chi^2(27) = 64.54$, $p < .001$; CFI = .99; TLI = 0.99; RMSEA = 0.04; SRMR = .04.
* $p < .05$. ** $p < .01$. *** $p < .001$.

occasion-specific variance was fairly stable from one assessment point to the next.

LGMs of Depression and Social Phobia

Unconditional LGMs of depression and social phobia were specified with the indicators described in the longitudinal measurement model in Table 1, and covariance of residual terms of the same indicators across factors was permitted. Partial measurement invariance for the factor loadings and indicator intercepts of the social phobia model was allowed, consistent with the tests reported in Table 1 (the depression model was found to be fully invariant). The majority of symptom change occurred between the first and second assessments, so the assumption of linear growth was untenable. To model the curvilinear trajectory of symptoms over time, we specified the following slope factor loadings: Time 1 = 0, Time 2 = freely estimated, and Time 3 = 1. This specification centers the intercept factor on Time 1, and the mean of the slope factor provides an estimate of average symptom change from Time 1 to Time 3 (i.e., the entire 1-year period) in the metric of the marker indicator of the latent variable outcome (see Bollen & Curran, 2006; T. A. Brown, 2007). In addition, factor intercepts were fixed to zero and the factor residual variances were constrained to equality.

The results of the LGMs of depression and social phobia are shown in Table 4. Both models fit the data well. The mean slope was significant and negative for both depression and social phobia, indicating that, on average, symptoms declined over time (Cohen's *d* from Time 1 to Time 3 = 0.60 for depression and 0.33 for social phobia, as estimated from the factor means, variances, and intercorrelations in the longitudinal measurement model). The freed Time 2 slope factor loading, interpreted as the proportion of total symptom change that occurred between Time 1 and Time 2, indicated that 87% and 88% of symptom change occurred during this initial 6-month period for depression and social phobia, respectively. For both disorders, individuals varied significantly in terms of initial severity levels (intercept variance) and symptom change over time (slope variance). Last, consistent with the findings of T. A. Brown (2007), the intercept and slope factors were significantly inversely correlated ($r = -.40$ for depression and $-.47$ for social phobia), meaning that decline in symptoms over time was more pronounced for participants with greater initial symptom severity.

Parallel-Process Models of Longitudinal Disorder–Temperament Associations

The TSO models for N/BI and BA/P were then combined with the LGMs for depression and social phobia to predict symptom change over time from the time-invariant (or "trait-like") components of temperament. The disorder slope was regressed on to the disorder intercept in all models to hold initial symptom severity constant. In addition, covariances were allowed between the time-variant components of temperament and the concurrent symptom

Table 4
Unstandardized Parameter Estimates From Unconditional Latent Growth Models of Depression and Social Phobia

Parameter	Depression[a]	Social phobia[b]
Intercept variance	20.86 (1.49)	335.57 (20.27)
Mean slope	−2.73 (0.18)	−5.42 (0.43)
Slope variance	9.09 (1.44)	65.02 (7.73)
Slope-intercept *r*	−.40 (.05)	−.47 (.04)

Note. $N = 826$. Standard errors appear within parentheses. All parameter estimates are significant at $p < .001$. Note that the unstandardized parameters for the latent growth model of depression differ from those reported by T. A. Brown and Rosellini (2011) because the current study used observed scores for the Depression scale of the Depression Anxiety Stress Scales (DASS-D; the marker indicator for the depression factors), whereas Brown and Rosellini (2011) performed a linear transformation on DASS-D scores (i.e., multiplied by 2).
[a] Model fit: $\chi^2(25) = 59.84$, $p < .001$; comparative fit index (CFI) = .99; Tucker–Lewis index (TLI) = 0.99; root mean square error of approximation (RMSEA) = 0.04; standardized root mean square residual (SRMR) = .03. [b] Model fit: $\chi^2(23) = 90.84$, $p < .001$; CFI = .99; TLI = 0.98; RMSEA = 0.06; SRMR = .02.

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factors (e.g., Time 1 time-variant BA/P with Time 1 social phobia) to account for shared variance between temperament and disorders that is specific to each assessment point. These covariances were constrained to equality across assessment points to foster model parsimony and identification.

First, four models were evaluated in which each temperament individually predicted change in each disorder (i.e., the time-invariant component of N/BI or BA/P predicting the slope of depression or social phobia). Next, the incremental contribution of each temperament was evaluated with two models predicting depression or social phobia from both temperaments simultaneously (see Figure 2 for an example). The time-invariant components of N/BI and BA/P were free to covary, as were the time-variant components across temperaments and within assessment points (e.g., Time 1 time-variant N/BI with Time 1 time-variant BA/P). Finally, a model with both temperaments and both disorders was tested to determine the unique contribution of each temperament to each disorder, adjusting for the shared variance between depression and social phobia. In addition to the covariances described above, correlations were allowed between the residual variances of the disorders within assessment points (e.g., Time 1 social phobia with Time 1 depression).

Fit was excellent for all disorder–temperament models (see Table 5 for fit indices and parameter estimates). The disorder intercepts significantly predicted symptom change in all models ($ps < .001$), and the direction of the associations was negative. Holding initial symptom severity constant, the time-invariant component of N/BI was predictive of change in depression and social phobia (standardized paths = .53 and .46, respectively; $ps < .001$), indicating that individuals with higher trait levels of N/BI had less symptom reduction over time. Similarly, symptom change was predicted by the time-invariant component of BA/P (path = −.38 for depression and −.31 for social phobia, $ps < .001$), such that those with higher trait levels of BA/P evidenced greater symptom reductions. Thus, after removing the time-variant component from temperaments and adjusting for initial disorder severity, each stable temperament remained a significant predictor of longitudinal symptom change.

Because N/BI and BA/P share substantial variance ($r = -.59$), we next examined models in which both temperaments were simultaneous predictors of change in each disorder, holding initial disorder severity constant. The time-invariant components of both N/BI and BA/P remained significantly predictive of change in depression (path from N/BI = .38, path from BA/P = −.29; $ps < .001$); it is noteworthy that adding N/BI to the model only negligibly reduced the association between BA/P and change in depression. For the model predicting change in social phobia from both temperaments simultaneously, N/BI remained a significant predictor of change in social phobia (path from N/BI = .38; $p < .001$), whereas BA/P approached statistical significance (path from BA/P = −.14; $p = .065$). Last, we evaluated a model that included both disorders and both temperaments to determine whether temperament predicts sources of shared variance among the disorders (i.e., comorbid symptoms) or if it is uniquely predictive of change in each disorder. After accounting for shared variance between the course of each disorder, N/BI and BA/P remained significant predictors of depression, with estimates essentially unchanged from the single disorder model described previously (path from

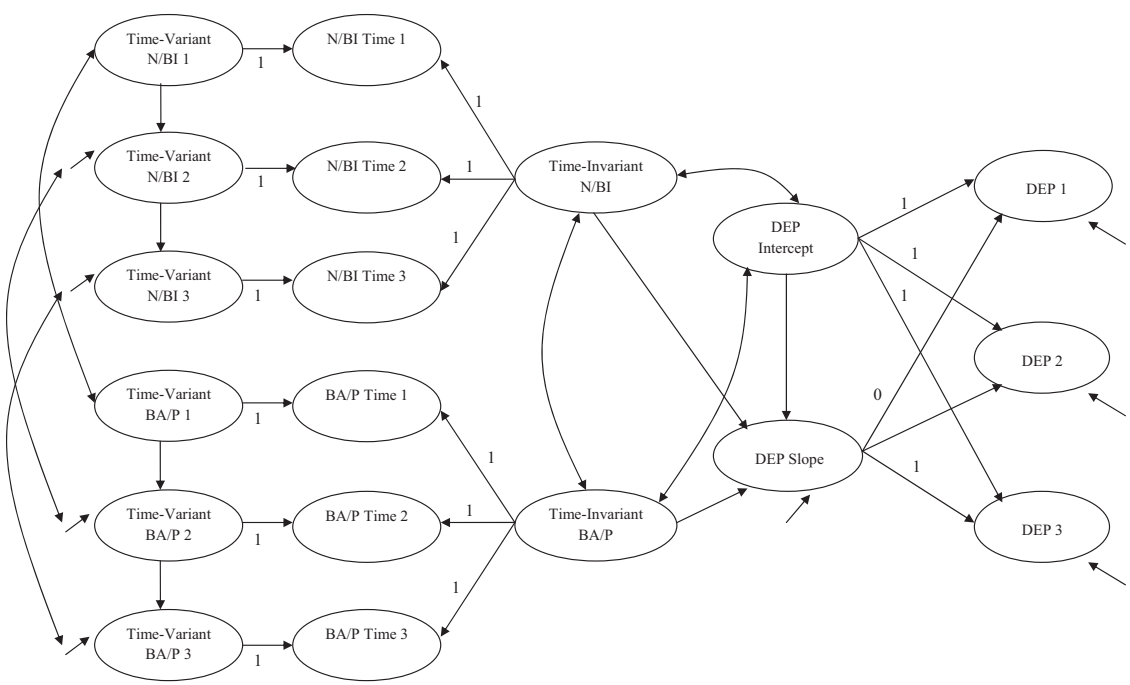

Figure 2. Parallel-process model of depression latent growth model with N/BI and BA/P trait–state-occasion model. DEP = depression; N/BI = neuroticism/behavioral inhibition; BA/P = behavioral activation/positive affect. For presentational clarity, factor indicators and covariances between time-variant temperament and depression factors (e.g., time-variant N/BI1 and DEP1) are not shown.

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Table 5
Standardized Regression Paths Predicting Disorder Slopes From Temperament, Holding Initial Disorder Severity Constant

Variable	Depression slope	Social phobia slope
Single temperaments with single disorders		
Time-invariant N/BI[a]	.53***	.46***
Disorder intercept	−.87***	−.77***
Time-invariant BA/P[b]	−.38***	−.31***
Disorder intercept	−.62***	−.66***
Both temperaments with single disorders[c]		
Time-invariant N/BI	.38***	.38***
Time-invariant BA/P	−.29***	−.14†
Disorder intercept	−.91***	−.81***
Both temperaments with both disorders[d]		
Time-invariant N/BI	.38***	.35***
Time-invariant BA/P	−.30***	−.14†
Depression intercept	−.93***	—
Social phobia intercept	—	−.80***

Note. $N = 826$. N/BI = neuroticism/behavioral inhibition; BA/P = behavioral activation/positive affect.
[a] Model fit for depression: $\chi^2(130) = 433.25$, $p < .001$; comparative fit index (CFI) = .97; Tucker–Lewis index (TLI) = 0.96; root mean square error of approximation (RMSEA) = 0.05; standardized root mean square residual (SRMR) = .08. Model fit for social phobia: $\chi^2(128) = 355.54$, $p < .001$; CFI = .98; TLI = 0.97; RMSEA = 0.05; SRMR = .06. [b] Model fit for depression: $\chi^2(130) = 287.53$, $p < .001$; CFI = .98; TLI = 0.98; RMSEA = 0.04; SRMR = .05. Model fit for social phobia: $\chi^2(128) = 345.63$, $p < .001$; CFI = .98; TLI = 0.98; RMSEA = 0.05; SRMR = .04. [c] Model fit for depression: $\chi^2(312) = 931.69$, $p < .001$; CFI = .95; TLI = 0.95; RMSEA = 0.05; SRMR = .08. Model fit for social phobia: $\chi^2(310) = 882.72$, $p < .001$; CFI = .96; TLI = 0.96; RMSEA = 0.05; SRMR = .07. [d] Model fit: $\chi^2(567) = 1570.39$, $p < .001$; CFI = .95; TLI = 0.95; RMSEA = 0.05; SRMR = .07.
† $p < .10$. *** $p < .001$.

N/BI = .38, path from BA/P = −.30; *p*s < .001). Similarly, the parameter estimates for change in social phobia were nearly identical to the single disorder model, with the BA/P path very close to conventional cutoffs for statistical significance (path from N/BI = .35, $p < .001$; path from BA/P = −.14, $p = .051$). Thus, the associations of temperament with depression and social anxiety were primarily predictive of the unique variance of each disorder, rather than the shared variance between the two disorders.

Discussion

The aim of this study was to evaluate the associations of temperament with the course of depression and social phobia in a clinical sample after statistically removing situation-specific variance in temperament such as mood-state distortion. We used the TSO latent variable model, which provided a more sophisticated methodology for addressing mood-state distortion than those used in prior studies with similar goals (e.g., T. A. Brown, 2007; Clark et al., 2003). As such, we were able to examine temperament–psychopathology associations with less of the transient "noise" that may obscure results and typically complicate their interpretations. Given that much of our knowledge about temperament–psychopathology associations is based on cross-sectional data, it is crucial to explore whether the observed associations seem to be authentic and robust, or if they are largely artifacts of occasion-specific influences such as mood-state distortion.

Our results support the former possibility: Even after accounting for initial symptom severity, for shared variance between the two temperaments, and for shared variance between the course of depression and social phobia, the time-invariant portion of N/BI was significantly predictive of change in depression and social phobia, such that higher levels of N/BI predicted less symptom reduction over time. Lower levels of BA/P were also a significant predictor of less symptom reduction in depression, but BA/P only approached significance in predicting change in social phobia after accounting for shared variance between N/BI and BA/P. One possible explanation for these results is that the stress reactivity associated with higher levels of N/BI and the reduced responsivity to positive stimuli associated with lower levels of BA/P may serve to maintain symptoms of depression and social phobia, even within a sample in which the majority of individuals were receiving treatment for their symptoms. These results are largely consistent with previous cross-sectional and longitudinal studies (e.g., T. A. Brown, 2007; T. A. Brown et al., 1998; Kasch et al., 2002; Naragon-Gainey et al., 2009; Watson et al., 2005), but the current study extends this literature with evidence of a robust longitudinal association independent of the influence of current mood state.

It is also noteworthy that temperament remained predictive of the course of depression and social phobia even after statistically accounting for shared variance between these highly comorbid disorders (e.g., Kessler, Chiu, Demler, Merikangas, & Walters, 2005). Temperament has often been linked to sources of comorbidity that confer a general genetic vulnerability for numerous internalizing disorders (e.g., Bienvenu et al., 2007; Hettema et al., 2006). The current study suggests that the "trait-like" component of temperament is also associated phenotypically with variance unique to each disorder beyond comorbidity.

Our specific hypotheses regarding the prediction of disorder course from temperament were supported with one exception: BA/P did not predict the course of social phobia at traditional levels of significance ($p = .065$) after accounting for shared

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variance with N/BI. Given the effect size of the parameter estimate and *p* value that approached significance, it is possible that sample-specific sources of error contributed to this nonsignificant finding and that a replication would yield a significant result. But regardless of significance, the BA/P–social phobia path is weaker than the other temperament–disorder paths in the current study. Some previous studies that attempted to isolate trait variance of temperament have also found that traits related to BA/P did not significantly predict internalizing psychopathology (T. A. Brown, 2007; Merz & Roesch, 2011; cf. T. A. Brown & Rosellini, 2011). Consistent with our findings, Merz and Roesch (2011) noted that state positive affect was associated with depression and anxiety, but trait positive affect was not. Perhaps the observed level of low extraversion/positive affectivity in these disorders (e.g., Kotov et al., 2010) is primarily due to shared variance with neuroticism/negative affectivity or to transient state effects like mood-state distortion, particularly for anxiety disorders such as social phobia. In addition, all of the above studies (including the current study) assessed extraversion/positive affectivity with heavy (or exclusive, in the case of Merz & Roesch, 2011) emphasis on positive affect and reward-responsiveness, rather than the sociability and dominance facets of extraversion. Given that the sociability and dominance facets are particularly relevant to social phobia (Naragon-Gainey et al., 2009), the effect of BA/P on social phobia may have been stronger if these facets were more strongly represented.

It is interesting to compare the results of the current study with those of T. A. Brown (2007), as the samples were nonoverlapping but the data were drawn from the same research center using similar assessment methods. Brown examined whether initial levels of N/BI and BA/P predicted change in disorder constructs over the course of 2 years. After partialing initial symptom severity and shared variance between N/BI and BA/P, Brown found a significant association between N/BI and social phobia. However, contrary to expectations, the associations of N/BI and BA/P with depression were nonsignificant. Similar to the current study, although BA/P was significantly associated with social phobia in single-process models, it approached but did not obtain statistical significance in predicting social phobia in parallel-process LGMs. In addition, the regression paths predicting the slopes of depression and social phobia from temperament were relatively weak in Brown (standardized estimates = |.04| to |.29|), whereas they were stronger in the current study (standardized estimates = |.14| to |.38|). The discrepancies in magnitude and statistical significance between the findings of Brown and the results of the current study illuminate the value of separating out trait and state components of temperament. Specifically, it appears that the removal of time-variant components bolsters the effects of temperament on the longitudinal course of emotional disorder psychopathology.[4]

The current study is one of very few to quantify the relative magnitudes of the time-invariant versus time-variant variance of temperament or personality traits. This issue is relevant to two fundamental assumptions in the study of temperament–psychopathology associations: (1) Traits are relatively stable over time, and (2) trait measures primarily detect this stable variance. Some researchers have argued that these assumptions do not hold for the self-reported traits of individuals with a current emotional disorder because reported traits are largely a function of clinical distress rather than premorbid temperament functioning (for discussions of this issue, see Clark et al., 2003; Costa et al., 2005; Santor et al., 1997). Although the current study could not address premorbid functioning because all participants entered the study seeking assessment or treatment for clinical disorders, we found evidence of substantial consistency in reports of temperament over the course of 1 year. The large majority of the variance in self-reported temperament was stable across the three assessment points, particularly for BA/P (N/BI = 57% to 71% time-invariant variance; BA/P = 77% to 78% time-invariant variance). This consistency is notable given the use of a treatment-seeking clinical sample that evidenced concurrent significant declines in symptoms that likely affected current mood state across assessments (*r*s between disorder factors and concurrent time-variant N/BI = .80 to .87; *r*s between disorder factors and concurrent time-variant BA/P = −.62 to −.75).

We found that the proportion of time-invariant variance for N/BI was substantially larger at baseline (71%) than at the two follow-up assessments (60% and 57%), whereas BA/P had a similar proportion of time-invariant variance across assessments. As noted previously, this pattern of findings is a function of the fact that N/BI's total variance was smallest at baseline, whereas the total variance for BA/P was constant across assessment points. The increase in N/BI variance over time is likely due to two specific features of this sample: (1) All participants had an anxiety or depressive disorder at baseline, and these disorders are all associated with elevated levels of N/BI (among the disorders included in this study, Cohen's *d* in a meta-analysis ranged from 0.92 for specific phobia to 2.07 for obsessive–compulsive disorder; Kotov et al., 2010), and (2) most of the sample received treatment for these disorders, which is known to reduce N/BI levels (e.g., Zinbarg, Uliaszek, & Adler, 2008). Thus, there was a restricted range at baseline for N/BI because all participants were disordered, but differential recovery over time increased the variance of N/BI at subsequent time points. In contrast, BA/P levels are less consistently elevated across diagnoses: In the Kotov et al. (2010) meta-analysis, extraversion levels ranged from $d = -0.20$ for social phobia to −1.47 for dysthymic disorder, and studies examining positive affectivity across the internalizing disorders have shown greater degrees of specificity to certain disorders (e.g., T. A. Brown et al., 1998; Watson et al., 2005). As such, the variance of BA/P was likely larger and did not change at the mean level throughout the study.

The finding of a large time-invariant component is consistent with a study that used the TSO model in a nonclinical adolescent/young adult sample in which about 84% and 82% of the variance

[4] To draw stronger conclusions regarding the impact of isolating time-invariant temperament variance, we conducted parallel-process LGM analyses identical to those of T. A. Brown (2007; i.e., predicting change in each disorder from the intercepts of both temperaments) in the current sample. This allowed a direct comparison of parameter estimates with and without the TSO approach in the same sample. Conducting LGM analyses in the current study largely replicated the pattern and magnitude of the results of Brown. All temperament predictors were weak or nonsignificant (largest standardized path = |.17|). In both samples, social phobia was significantly predicted by N/BI but not BA/P. For depression, N/BI was not a significant predictor in either sample; BA/P was nonsignificant in Brown ($p < .05$) but was weakly significant in the current sample ($p = .03$). This replication of Brown bolsters confidence in the conclusion that isolating time-invariant temperament variance enhances the effects of temperament on the longitudinal course of depression and social phobia. Full results from these analyses are available on request from the first author.

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in neuroticism and extraversion, respectively, was time-invariant over the course of 3 years (Prenoveau et al., 2011). Interestingly, Prenoveau and colleagues (2011) reported comparably high proportions of time-invariant variance for some anxiety symptoms (i.e., social phobia and specific phobia), consistent with increasing evidence that some symptoms are as stable or more stable than some personality traits (see also Clark, 2009; Roberts & Mroczek, 2008; Shea & Yen, 2003). The size of "trait" variance in temperament needs to be further examined in other samples and with other measures, but the converging results of the current study and Prenoveau et al. provide some support for the validity of self-reported temperament and for the existence of substantial stable variance in neuroticism/negative affectivity and extraversion/positive affectivity measures.

The current study has several strengths including the use of a large, clinical sample that was assessed at multiple time points, as well as multiple indicators of each construct and a combination of self-report and clinician-rated psychopathology measures. However, several limitations should be acknowledged. As described previously, participants in the current sample were already experiencing clinically significant symptoms; therefore, we were unable to assess the impact of temperament on the initial development of depression and social phobia. It is also possible that the high levels of distress found in clinical samples (and the associated restrictions of range for symptoms and traits) may give a limited view of these processes, as compared with a sample with a broader range of functioning. Given that T. A. Brown (2007) found that N/BI was less stable at lower initial levels, results may differ in samples with lower levels of clinical distress.

Because most of the sample received therapy within the first 6 months of the study, the majority of symptom change occurred between the first and second time points. More frequent assessment during this time would have provided finer grained information about the nature of the covariance of temperament and symptom change, and the study length of 1 year was relatively brief. Although we are not aware of evidence that treatment changes the nature or magnitude of the associations between personality and symptoms, it is notable that the current sample was heterogeneous with regard to treatment status (74% received treatment).[5] Some researchers have posited that there may be an interaction between treatment efficacy and temperament, such that higher levels of initial N/BI would be associated with less symptom reduction in treatment (Zinbarg et al., 2008). Although beyond the scope of the current study, this interaction would be interesting to examine in future studies. Finally, we did not examine stressful life events that may have influenced the course of disorders or potentiated the effects of temperament (see T. A. Brown & Rosellini, 2011) or facets within N/BI or BA/P that may be differentially associated with depression and social phobia (see Naragon-Gainey et al., 2009).

In summary, the current study found evidence of significant associations of two major temperamental traits with the course of depression and social phobia after statistically removing the influences of situational factors such as current mood. Furthermore, our findings suggest that this analytical approach reveals stronger effects of temperament on psychopathology than do analyses that conflate time-variant and time-invariant temperament variance. A variety of temporal and theoretical mechanisms have been proposed to explain the associations between temperament and psychopathology (e.g., Widiger & Smith, 2008). Although the current study is supportive of the pathoplasty model (i.e., traits affect the course, severity, or expression of existing psychopathology), it will be important to test other causal models (e.g., vulnerability model, spectrum model) in samples without disorders at baseline. Nevertheless, separating time-invariant and time-variant variance is likely most germane for currently disordered samples, given the presence of clinical distress. Future studies should examine models that include other disorders and other traits with this methodology. In addition, applying the TSO model to various temperament or personality measures can reveal which seem most effective in tapping the time-invariant variance that is typically of interest to researchers and clinicians. We look forward to the continued application of this methodology to further clarify the links between enduring elements of temperament and emotional disorders.

[5] We examined the possible impact of treatment on temperament–symptom associations by conducting the LGM TSO parallel-process analyses (i.e., each symptom predicted by both temperaments) in the subset of the sample that received treatment. Model fit was virtually identical to the analyses that included the whole group, and the standardized paths between each temperament and symptom were not substantially different from those of the models with the full group (i.e., any discrepancies in parameter estimate magnitudes were less than 1 standard error).

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