Prospective Evaluation of a Cognitive Vulnerability-Stress Model for Depression: The Interaction of Schema Self-Structures and Negative Life Events

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This study tested the diathesis-stress component of Beck's (1967) cognitive theory of depression. Initially, participants completed measures assessing cognitive organization of the self-schema and depressive symptoms. One year later, participants completed measures assessing cognitive organization of the self-schema, depressive symptoms, and negative life events. Hierarchical multiple regression analyses, controlling for initial depression, indicated that more tightly interconnected negative content was associated with greater elevations in depressive symptoms following the occurrence of life events. More diffusely interconnected positive content for interpersonal self-referent information also interacted with life events to predict depressive symptoms. Cognitive organization dimensions showed moderate to high stability across the follow-up, suggesting that they may be trait-like vulnerability factors. Implications for the cognitive vulnerability-stress model of depression are discussed. © 2010 Wiley Periodicals, Inc. J Clin Psychol 66:1307–1323, 2010.

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A vast body of research has proposed diathesis-stress models of depression, including cognitive factors (see Dozois & Beck, 2008, for review). Beck's (1967) model of depression is based upon several cognitive concepts, including schemas. Schemas have been defined as "relatively enduring internal structures of stored generic or prototypical features of stimuli, ideas, or experiences that are used to

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organize new information'' (Clark, Beck, & Alford, 1999, p. 79). When activated, depressive schemas affect the filtering, encoding, processing, interpretation, storage, and retrieval of information in a negatively biased way (Dozois & Beck, 2008).

According to Beck's theory (1967), depressive self-schemas develop in early childhood in response to adverse experiences and remain dormant until they are triggered by a later stressful life event. From this diathesis-stress perspective, the self-schema influences how individuals interpret and experience stressful events, thereby moderating the impact of stressful events on the development of dysphoria (Riskind & Alloy, 2006). For those individuals with a cognitive vulnerability (e.g., depressive self-schema), the experience and dysfunctional appraisal of a particular environmental stressor contributes to depression (Ingram & Luxton, 2005). For those individuals without vulnerability, the experience of a stressful life event leads to appropriate levels of negative mood and negative thoughts, which do not subsequently develop into depression (Ingram, Miranda, & Segal, 1998).

Several studies have examined cognitive diathesis-stress models of depression, focusing on the relationships between the content of an individuals' schema(s) (i.e., dysfunctional or maladaptive concepts, beliefs, or attitudes about the self, the personal world, and the future) and risk of depression (for reviews, see Abela & Hankin, 2008; Abramson et al., 2002; Lakdawalla, Hankin, & Mermelstein, 2007; Scher, Ingram, & Segal, 2005). One commonly used method of assessing negative schema *content* is the Dysfunctional Attitudes Scale (DAS; Weissman & Beck, 1978). The majority of longitudinal studies have found support for Beck's diathesis-stress model (Brown, Hammen, Craske, & Wickens, 1995; D'Alessandro & Burton, 2006; Hankin, Abramson, Miller, & Haeffel, 2004; Joiner, Metalsky, Lew, & Klocek, 1999; Kwon & Oei, 1992; Reilly-Harrington, Alloy, Fresco, & Whitehouse, 1999); however, some have yielded partial or mixed results (Abela & D'Alessandro, 2002; Abela & Sullivan, 2003; Dykman & Johll, 1998; Lewinsohn, Joiner, & Rhode, 2001; Voyer & Cappeliez, 2002), and some have yielded no support (Alloy, Reilly-Harrington, Fresco, Whitehouse, & Zechmeister, 1999; Barnett & Gotlib, 1988, 1990; Kuiper & Dance, 1994; Otto et al., 2007). Overall, the results are consistent with a general pattern in which DAS scores interact with negative stressful life events to predict depression. Importantly, there is evidence that the interaction of self-schema content and stressful life events prospectively predicts the *onset* of major depression and not just increases in depressive symptoms (Evans, Heron, Lewis, Araya, & Wolke, 2005; Hankin et al., 2004; Lewinsohn et al., 2001).

Beyond simple two-point prospective assessments, multiwave and time-lagged studies have examined diathesis-stress models to provide a more stringent exploration of this hypothesis (e.g., Abela & Skitch, 2007; Hankin, Wetter, Cheely, & Oppenheimer, 2008; Klocek, Oliver, & Ross, 1997). For example, a four-wave study with community adolescents found that dysfunctional attitudes interacted with negative life events to predict elevations in anhedonic depressive symptoms specifically, but not general depression, anxious arousal, or externalizing symptoms (Hankin et al., 2008). Similarly, a three-wave study with undergraduate students reported that high levels of dysfunctional attitudes and high levels of stress predicted higher depressive symptomatology (Klocek et al., 1997).

Although less often researched, schemas can also be expressed in terms of their *structural* characteristics, or how the information contained within them is organized. Cognitive structure can be defined as the ''architecture of the system…how information is stored and organized" and would subsume cognitive constructs such as the various memory systems, neural networks, and associative linkages (Ingram et al., 1998, p. 15). According to Beck's cognitive theory, schemas may differ in their degree of interrelatedness of the ideas or elements contained within them (Dozois & Beck, 2008).

Information that is important to one's self is processed more efficiently than less self-relevant information (e.g., Matt, Vázquez, & Campbell, 1992). This increased processing efficiency suggests that self-relevant ideas may be better organized or interconnected in the self-schema than would less self-referent ideas. If a schema's ideas or elements are highly interrelated, they would presumably be more easily activated and exert a greater influence on subsequent emotions (e.g., Bower, 1981) and on the information processing system (Clark et al., 1999). This "priming" occurs (in conjunction with negative life events and other stimuli) because tightly interconnected schema elements tend to have a lower activation threshold due to the activation of one element triggering that of others (Segal, 1988). Similarly, if a schema contains a larger number of interrelated ideas or elements, it will have a greater influence on information processing simply because the schema can be activated by a wider array of stimuli (Ingram et al., 1998). Thus, depressed persons and individuals vulnerable to depression would be expected to have negative self-referent beliefs that are more tightly interconnected than the negative self-referent beliefs of individuals without depression (Clark et al., 1999; Ingram et al., 1998).

The Psychological Distance Scaling Task (PDST; Dozois & Dobson, 2001b) was developed to assess the self-schema structure by having participants place self-referent adjectives on a grid based on the degree of self-descriptiveness and valence of each word. Studies using this method have been successful in differentiating between the self-schema structures observed in depression and anxiety (Dozois & Dobson, 2001b; Dozois & Frewen, 2006), distinguishing the organization of schema content in non-dysphoric, mildly dysphoric, and moderately-severely dysphoric individuals (Dozois, 2002), demonstrating stability in self-referent schema organization upon remission from depression (Dozois, 2007; Dozois & Dobson, 2001a), and indicating which patterns of schema organization are related to depression recurrence (Dozois & Dobson, 2003). Thus, examining schema structure using this methodology provides a metric for testing the relationship between cognition and life events and for gaining additional insight into cognitive vulnerability to depression.

Overall, research on self-schema structure has shown that more severe symptoms of dysphoria and depression are associated with greater interconnectedness of negative self-referent information and decreased interconnectedness of positive self-referent information. These constructs are considered to be distinct yet related, in that they each have a unique relationship with the presence/absence of depression. The depressotypic pattern of organization for positive information diminishes once the depressive mood state lifts (i.e., mood-state dependent), whereas the depressotypic pattern of organization for negative information remains stable even following remission of the depressive symptoms (Dozois, 2007; Dozois & Dobson, 2001a). Hence, organization of negative self-referent content (especially for interpersonal content) appears to be a stable trait-like marker for vulnerability to depression (Dozois & Dobson, 2001b; Dozois & Frewen, 2006). Recently, a randomized clinical trial for depression examined changes in self-schema structure over the course of cognitive therapy (CT) plus pharmacotherapy versus pharmacotherapy alone (Dozois et al., 2009). Individuals who were treated with combination therapy (CT+pharmacotherapy) showed greater cognitive organization of interpersonal positive content and less organization for interpersonal negative content than did those treated with pharmacotherapy alone. This is the first evidence to suggest that the trait-like vulnerability of highly interconnected negative self-structure can be modified by CT plus pharmacotherapy.

Self-schema structure may satisfy the criteria for a vulnerability factor within Ingram et al.'s (1998) classification system (i.e., stable trait, endogenous, latent, and triggered by stress). Based on previous work using the PDST, there is evidence for specificity of particular patterns of organization to the construct of depression, as well as sensitivity for the severity of depression and likelihood of recurrence (e.g., Dozois & Dobson, 2001a, 2001b, 2003; Dozois, 2007). These results suggest that schema structure, as measured by the PDST, may satisfy the first four criteria outlined by Ingram and colleagues. However, no previous studies have investigated the diathesis-stress component of this definition using self-schema structure as the proposed cognitive vulnerability factor.

Thus, the principal aim of this study was to determine whether a depressotypic pattern of cognitive organization interacts with negative life events to predict depressive symptoms and potentially precipitates the onset of a depressive episode as hypothesized by Beck's (1967) model. A secondary objective was to assess the stability of cognitive organization over a 1-year period. We hypothesized that cognitive organization of the self-schema would interact with stress to predict depressive symptoms one year later, controlling for baseline depressive symptoms. More specifically, we hypothesized that more tightly interconnected content for negative information and more diffusely interconnected content for positive information would each, respectively, interact with negative life events on a 1-year time period to predict self-reported depression severity.[1] In exploratory analyses, we also examined the stability of cognitive organization across a 1-year time frame.

Method

Participants

Participants were 57 undergraduate students (44 women and 13 men) with a mean age of 20.82 ($SD = 6.76$) years recruited from a large university. Two hundred and three undergraduate students were initially recruited (T1) from introductory psychology classes at the University of Western Ontario, London, Ontario, Canada. Fifty-seven participants returned at follow-up (T2), 1 year later (28% retention rate). The 57 students who participated at both time points did not differ on age, gender, marital status, ethnicity, self-reported depression symptom severity, history of diagnosis or treatment for a mental disorder, or any of the cognitive organization variables (all $ps > .05$) compared to the 146 who did not return. Of the participants who completed both waves of data collection, 94.7% were single/unmarried.

[1]Given that we assessed depressive severity using the BDI-II in an unselected sample of undergraduate students, the findings of the present study are merely an analogue to the construct of clinical depression and its vulnerability factors. It is possible that in nonclinical samples such as this, more general experiences of negative emotional states are described as opposed to clinical depression. As a result, we will use the terms *dysphoria* or *self-reported depressive severity* to refer to this construct to prevent misunderstanding (see Haaga & Solomon, 1993; Kendall, Hollon, Beck, Hammen, & Ingram, 1987).

The ethnic makeup of the sample was predominantly Caucasian (66.7%), followed by Asian Canadian (29.8%), and African Canadian (3.5%).

Measures

Demographic information. A basic demographics questionnaire was administered to participants to assess various demographic (age, gender, ethnicity, marital status) and clinical (history of previous mental illness, previous psychological or psychiatric treatment) characteristics.

Depression severity. The Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996) was completed by all participants to assess the severity of depressive symptoms. The BDI-II is a standardized 21-item self-report measure of depression. Participants rate each item on a 4-point scale, from 0 to 3, by selecting the statement for a given question that best matches their mood in the preceding 2 weeks (Beck et al., 1996). A total score is calculated by summing across the items and can range from 0 to 63, with higher scores indicating greater severity of depression. The BDI-II demonstrates excellent internal reliability (average coefficient alpha = .91), good test-retest reliability (ranging from .60 to .83 for nonpsychiatric samples), and excellent content, construct, concurrent, and discriminant validity (see Dozois & Covin, 2004, for review). The internal consistencies (Cronbach's α) of this scale for our sample were .93 and .95, at T1 and T2, respectively.

Self-schema structure. The Psychological Distance Scaling Task (PDST; Dozois & Dobson, 2001b) is a cognitive task that entails participants placing self-referent adjectives on a grid based on the simultaneous rating of the self-descriptiveness and valence of the word. Participants were seated in front of a computer screen and were presented with an almost-square grid (21.5 cm by 23 cm). Along the x-axis, self-descriptiveness ranged from *very much like me* at the far right of the axis to *not at all like me* at the far left of the axis. Along the y-axis, valence was rated from *positive* at the top of the axis to *negative* at the bottom. Each adjective was presented at the center of the grid and participants were asked to place the word on the grid somewhere, based on the two axes, using a visually presented pointer and a computer mouse. There were four practice trials and 80 target adjectives for participants to rate. After each trial, participants were asked to confirm their adjective placement before proceeding to the next trial. If the response was not what they had intended, participants were given a chance to make their response again. Following each response, a new grid and new adjective were displayed on the screen until all 80 target adjectives had been presented. This task has been used in prior studies examining cognitive organization in clinical and nonclinical samples (Dozois, 2002, 2007; Dozois et al., 2009; Dozois & Dobson, 2001a,b, 2003; Dozois & Frewen, 2006). The 80 target adjectives used in the current study were identical to those used in previous studies and have been matched for emotional intensity, imaginability, word length, and word frequency (Dozois, 2007; Dozois & Frewen, 2006). The set of 80 adjectives consisted of 20 words in each of the following categories: interpersonal positive (e.g., *encouraged*, *comforted*), interpersonal negative (e.g., *unwanted*, *rejected*), achievement positive (e.g., *successful*, *capable*) and achievement negative (e.g., *incompetent*, *deficient*). The interrater reliability for the content domain of each of these 80 adjectives is excellent (94% agreement; $\kappa = .87$; Dozois, 2007; Dozois & Frewen, 2006).

To compute the average interstimulus distance among the positive and negative adjectives, the computer calculated a coordinate point (x- and y-axis) for each adjective. Interstimulus distances for self-referent positive and self-referent negative content were computed using the following idiographic formula:

$$\frac{\sqrt{\sum \begin{matrix}(X_1 - X_2)^2 + (X_1 - X_3)^2 + \cdots + (X_{19} - X_{20})^2 + \\ (Y_1 - Y_2)^2 + (Y_1 - Y_3)^2 + \cdots + (Y_{19} - Y_{20})^2\end{matrix}}}{n(n-1)/2}$$

where X is the adjective placement on the self-descriptiveness axis, Y is the adjective placement on the valence axis, and n is the total number of self-descriptive adjectives. Therefore, the average interstimulus distances for a particular content of self-referent adjectives equals the square root of the mean squared distances of every adjective–adjective combination, divided by the total number of possible distances for that content area (see Dozois & Dobson, 2001b for additional information concerning the development of this measure).

Interstimulus distance scores were calculated for six areas of self-referent information: overall positive, overall negative, interpersonal positive, interpersonal negative, achievement positive, and achievement negative adjectives. Scores for the present study were logarithmically transformed to compensate for violations in the normality of the distribution. Hence, all scores reported and used in subsequent analyses are log scores. The fundamental assumption of this task is that smaller distance among adjectives is indicative of greater interconnectedness or consolidation of self-referent content, whereas larger distance among adjectives is indicative of less interconnectedness or consolidation. Psychometric properties of this measure have been supported in other research papers (Dozois, 2002; Dozois & Dobson, 2001b, 2003).

Life events. The Negative Life Events Questionnaire (NLEQ; Metalsky & Joiner, 1992) was used to assess negative life events that may occur in the lives of young adults. Items assess negative life events in different domains, such as academic achievement and interpersonal stressors (e.g., "Not doing as well in school as you would like," "Fight or disagreement with romantic partner"). We included 66 items in the present investigation, similar to previous use of this measure in studies examining diathesis-stress interactions and depression (e.g., Metalsky & Joiner, 1992). Scores consisted of the number of events endorsed as having been present during the past year and ranged from 0 to 66. Higher scores reflect the occurrence of more negative events. For the current study, participants were instructed to indicate which of these 66 events had occurred to them over the past year. Item response on the NLEQ varies according to the type and frequency of the life stress experiences; thus, the calculation of internal consistency coefficients is not appropriate for this particular scale. The NLEQ's validity has been demonstrated in several previous vulnerability and stress studies (e.g., Hankin, 2005; Hankin et al., 2004; Metalsky & Joiner, 1992). The NLEQ was given at T2.

Procedure

During the initial assessment (T1), participants provided informed consent and completed the demographic questionnaire, BDI-II, and PDST. They received course credit for their participation. Approximately 1 year later (T2; $M = 55.09$, $SD = 2.33$ weeks), participants returned to the laboratory and met with a researcher. At this time, they completed a consent form, the PDST, the BDI-II, to assess changes in self-reported depressive symptoms, and the NLEQ, to assess experiences of negative life events over the intervening year. Following this, the mood disorders module from the Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Non-patient Edition (SCID-I/NP; First, Spitzer, Gibbon, & Williams, 2005) was conducted to determine past and present diagnoses of mood disorders.[2] After completing all of these materials, participants were debriefed and compensated $20 for their time.

Results

Sample Descriptive Characteristics

According to responses on a self-report demographic questionnaire, 14.0% of the sample who participated at both time points reported a history of a mental disorder (e.g., unipolar major depression, eating disorder, anxiety disorder) and 10.5% reported a history of treatment for a mental disorder (e.g., medication, counseling). Individuals with a clinician-diagnosed history of mood disturbance had significantly greater interstimulus distances in their T1 overall positive, interpersonal positive, and achievement positive scores, and significantly smaller interstimulus distances in their T1 overall achievement negative scores than those without such a history (all ps $< .05$).[3]

BDI-II scores for the longitudinal sample were significantly correlated over the 1-year test-retest interval, $r = .83$, $p < .001$. Although BDI-II scores were slightly higher at T1 ($M = 12.49$, $SD = 12.14$) than at T2 ($M = 11.63$, $SD = 11.11$), this difference was not statistically significant, $t(56) = -0.94$, $p = .35$. BDI-II scores for the present sample were consistent with those reported in other nonclinical samples (Dozois & Covin, 2004). The average number of events that participants reported experiencing at some point during the 1-year interval was 25.63 ($SD = 11.32$, min = 3, max = 59). This is consistent with the rates of self-reported life events using the NLEQ with other undergraduate samples (Hankin, 2005; Hankin et al., 2004). Participant scores on the BDI-II, PDST, and NLEQ did not differ as a function of gender, ethnicity, or age (all ps $> .05$).

Stability of Self-Schema Structure Over One Year

Bivariate correlations were conducted to examine the stability of self-schema structure over a 1-year period. The correlations of interpersonal and achievement content (positive and negative) within each time interval are presented in Table 1.

[2]The prevalence of current mood disorder diagnoses of the present sample included the following: (a) major depressive disorder ($n = 3$), (b) major depressive disorder in partial remission ($n = 1$), and (c) adjustment disorder with depressed mood ($n = 3$). Of those currently not experiencing a mood disturbance the prevalence of past mood disorder diagnoses was as follows: (a) major depressive disorder ($n = 3$), (b) adjustment disorder with depressed mood ($n = 6$), and (c) substance-induced mood disorder with depressive features ($n = 1$). The remaining 41 participants did not meet current or past criteria for any Axis I mood disorder. The presence of comorbid Axis I disorders was not assessed.

[3]Differences in the self-schema structure between those with and without a history of a diagnosed depressive disorder raise the possibility that any depressotypic patterns of cognitive organization observed in our sample may be the result of a prior experience with depression rather than predisposing cognitive vulnerabilities (i.e., "scar hypothesis"; Zeiss & Lewinsohn, 1988). As a result, we are unable to make inferences about the causal nature of self-schema structure in predicting first-onset increases in depressive symptoms or episode.

Table 1
Bivariate Correlations Within Time Points for Psychological Distance Scaling Task Interstimulus Distances

	Overall positive	Overall negative	Interpersonal positive	Interpersonal negative	Achievement positive	Achievement negative
Overall positive	–	−.45***	.88***	−.46***	.94***	−.61***
Overall negative	−.59***	–	−.44***	.84***	−.38**	.79***
Interpersonal positive	.87***	−.49***	–	−.51***	.73***	−.57***
Interpersonal negative	−.44**	.91***	−.37**	–	−.36*	.47**
Achievement positive	.92***	−.58***	.65***	−.43**	–	−.54***
Achievement negative	−.56***	.89***	−.45**	.62***	−.55***	–

Note: Correlations within T1 are presented above the diagonal; correlations within T2 are presented below the diagonal. Lower interstimulus distances refer conceptually to a tighter, more interconnected self-schema structure, whereas higher interstimulus distances refer to a diffuse, less-interconnected self-schema structure.
*$p < .05$; **$p < .01$; ***$p < .001$.

Stability coefficients/correlations between the same construct across the 1-year period (e.g., interpersonal negative at T1 and interpersonal negative at T2) were all significant at the .001 level as follows: overall positive, $r = .73$; overall negative, $r = .63$; interpersonal positive, $r = .73$; interpersonal negative, $r = .60$; achievement positive, $r = .65$; achievement negative, $r = .64$. These coefficients are consistent with previous work reporting 6-month test-retest reliability coefficients for individuals who remain clinically depressed for negative and positive interpersonal content as .70 and .51, respectively (Dozois & Dobson, 2001a).

Multiple Regression Analyses Examining Diathesis-Stress Models

The primary question of interest was whether cognitive organization, as measured by the PDST, interacted with negative life events to predict level of T2 self-reported depressive symptoms, above and beyond the influence of T1 self-reported depression severity. To test this question, setwise hierarchical multiple regression analyses were utilized (see Hankin et al., 2004; Metalsky & Joiner, 1992). In these analyses, a set of covariates is entered first into the regression equation, followed by the entry of sets of independent variables. This procedure is particularly useful when the dependent variable is a post-score measure (e.g., T2 self-reported depressive symptoms) and the covariate is a prescore measure (e.g., T1 self-reported depressive symptoms). To control for overlapping variance with the predictor variables, T1 BDI-II scores were entered on the first step of the regression. On the second step, the main effects of T1 cognitive organization interstimulus distances (i.e., one of: overall positive, overall negative, interpersonal positive, interpersonal negative, achievement positive, or achievement negative from the PDST) and T2 negative events (NLEQ) were entered as separate variables. On the third step, the interaction of T2 NLEQ $\times$ T1 Cognitive Organization was entered.[4] To accommodate the different types of cognitive organization, hierarchical regression analyses were run to test each type of

[4]Some researchers suggest that diathesis-stress analyses combining stressors of different severities (i.e., daily hassles and major life events) may give the wrong impression (e.g., Monroe & Simons, 1991). With this in mind, all diathesis-stress analyses were repeated using only hassles or only major life events interacting with cognitive structure to predict student dysphoria at T2. The same general pattern of results was obtained as is reported in the main body of this article where major life events and daily hassles are combined together into a general count of negative stressors.

cognitive organization in the model individually. In all analyses, all variables were standardized prior to the calculation of interaction terms or to entry in the models.

Results for the general models containing overall positive and negative self-schema structure are shown in Table 2. As these results demonstrate, the NLEQ had a significant main effect, independent of the overall negative and overall positive domains of PDST cognitive self-structure, in predicting residual changes in BDI-II scores from T1 to T2. Importantly, on the critical test of the vulnerability-stress component, the negative structure PDST $\times$ NLEQ interaction was a significant predictor of T2 self-reported depressive symptoms, and positive structure PDST $\times$ NLEQ a predictor at a trend level.

To follow-up on these general models, four subdomains of the self-schema content using the PDST (interpersonal positive, interpersonal negative, achievement positive, and achievement negative) were examined in hierarchical multiple regression models. As demonstrated in Table 3, the main effect was significant for the NLEQ, independent of all four content domains of PDST cognitive self-structure, in predicting residual changes in BDI-II scores from T1 to T2. Importantly, the critical test of the vulnerability-stress component, the PDST $\times$ NLEQ interaction, predicted T2 self-reported depressive symptoms in three out of four of the content domains (interpersonal positive, interpersonal negative, and achievement negative).[5,6]

These analyses show that the cognitive vulnerability $\times$ stress interaction predicts T2 dysphoria. Simple slope analyses were conducted at high, moderate, and low levels of interstimulus distances to determine the effect of negative life events on depressive severity at different levels of self-schema structure (Aiken & West, 1991). At high and moderate levels of interstimulus distances (i.e., diffuse, conceptually less interconnected) for interpersonal positive information, a higher proportion of negative life events was associated with increased T2 depressive severity, but at low levels of interstimulus distances (i.e., close, conceptually more interconnected) for interpersonal positive self-referent information, there was no significant relationship between negative life events and T2 depression. At low and moderate levels of interstimulus distances (i.e., closer) for both interpersonal and achievement negative information, greater negative life events was associated with higher T2 depressive severity; however, at high (i.e., more diffuse) levels of interstimulus distances for interpersonal and achievement negative content, there was no significant relations between negative life events and T2 depression.

Discussion

The purpose of this study was to examine self-schema structure as a cognitive vulnerability factor within a diathesis-stress model of depression. We hypothesized

[5]To explore the possibility that our pattern of results may, in part, be influenced by the inclusion of participants with a history of a depressive disorder, we ran the main analyses both excluding these participants and only including these participants. In both sets of analyses, none of the main results were replicated (all were not significant, $ps > .05$). Because of the significantly reduced power of these analyses, it is difficult to draw conclusions about the impact of participant's history of depression on the diathesis-stress interactions. Future studies utilizing larger sample sizes are needed to disentangle this issue.

[6]To examine the incremental validity of interstimulus distances in providing additional information above and beyond participants' average level of endorsement and valence, our main analyses were repeated controlling for the average of the x- or y-axis information from the PDST. In all of these models, our original findings were replicated. This suggests that the interaction between interstimulus distances scores from PDST and negative life events provide a significant, independent contribution to the prediction of diathesis-stress models.

Table 2
Cognitive Vulnerability, Negative Life Events, and Interaction Predicting T2 Depressive Symptoms Controlling for T1 Symptoms

Predictor	ΔF	ΔR^2	*df*	*pr* (Partial correlation)	β	*t*
Overall positive structure ($n = 57$)						
Step 1	120.61***	.69	1, 55			
T1 BDI-II				.83	.83	10.98***
Step 2	5.91**	.06	2, 53			
T1 PDST: Positive				−.05	−.04	−.39
T2 NLEQ				.42	.27	3.42**
Step 3	3.53†	.02	1, 52			
T1 PDST: Positive × T2 NLEQ				.25	.15	1.88†
		Model $R^2 = .76$, F (4,52) = 41.20, $p < .001$				
Overall negative structure ($n = 55$)						
Step 1	115.94***	.69	1, 53			
T1 BDI-II				.83	.83	10.77***
Step 2	5.76**	.06	2, 51			
T1 PDST: Negative				−.06	−.04	−.43
T2 NLEQ				.43	.27	3.39**
Step 3	9.97**	.04	1, 50			
T1 PDST: Negative × T2 NLEQ				−.41	−.23	−3.16**
		Model $R^2 = .79$, F (4,50) = 46.08, $p < .001$				

Note: BDI-II = Beck Depression Inventory-II; NLEQ = Negative Life Events Questionnaire; PDST = Psychological Distance Scaling Task.
†$p = .07$; **$p < .01$; ***$p < .001$.

that self-structure interconnectedness, as assessed by the PDST, would interact with negative life events to predict depressive symptoms. Specifically, we predicted that more tightly interrelated negative self-structure and more diffusely interrelated positive self-structure would be the patterns of self-schema organization that would confer the greatest "vulnerability" (i.e., be associated with future depressive symptoms). This hypothesis was tested prospectively across a 1-year follow-up interval using well-validated measures for an undergraduate sample. Additionally, the relative stability of the constructs assessed by the PDST was examined, as a way of further testing the possibility that cognitive self-structure may be a cognitive vulnerability factor for depression.

Consistent with hypotheses, patterns of self-structure interconnectedness were moderately to highly stable across a 1-year period, suggesting that the construct being measured by the PDST may be relatively trait-like in individuals. This finding is consistent with previous studies that have shown that negative self-schema structures tend to remain stable in individuals during their depressive episode and upon remission (Dozois, 2007; Dozois & Dobson, 2001a). Furthermore, the relative stability of the constructs measured by the PDST, as evidenced by the moderate to high correlations (*r*s ranging from .60 to .73), is similar to those reported in other studies examining the stability of other cognitive vulnerability factors for depression in adolescents and adults (Farmer, Harris, & Redman, 2001; Hankin, 2008b; Romens, Abramson, & Alloy, 2009). Generally, adult studies have found that dysfunctional attitudes are moderately to highly stable ($r = .53$ for 10–12 months in depressed adults; $r = .70$ for 10–12 months in nondepressed adults; Farmer et al., 2001). No studies, to our knowledge, have examined the stability of self-schema structure over a 12-month period. This finding provides additional support for the

Table 3
Cognitive Vulnerability (Interpersonal and Achievement), Negative Life Events, and Interaction Predicting T2 Depressive Symptoms Controlling for T1 Symptoms

Predictor	ΔF	ΔR^2	*df*	*pr* (Partial correlation)	β	*t*
Interpersonal positive structure ($n = 57$)						
Step 1	120.61***	.69	1, 55			
T1 BDI-II				.83	.83	10.98***
Step 2	6.20**	.06	2, 53			
T1 PDST: IP				−.11	−.07	−.80
T2 NLEQ				.43	.28	3.48**
Step 3	4.82*	.02	1, 52			
T1 PDST: IP × T2 NLEQ				.29	.16	2.19*
	Model $R^2 = .77$, F (4,52) = 42.97, $p < .001$					
Interpersonal negative structure ($n = 50$)						
Step 1	101.64***	.68	1, 48			
T1 BDI-II				.82	.82	10.08***
Step 2	7.55**	.08	2, 46			
T1 PDST: IN				−.03	−.02	−.22
T2 NLEQ				.50	.32	3.89***
Step 3	7.53**	.04	1, 45			
T1 PDST: IN × T2 NLEQ				−.38	−.20	−2.74**
	Model $R^2 = .79$, F (4,45) = 43.13, $p < .001$					
Achievement positive structure ($n = 57$)						
Step 1	120.61***	.69	1, 55			
T1 BDI-II				.83	.83	10.98***
Step 2	5.82**	.06	2, 53			
T1 PDST: AP				.01	.01	.08
T2 NLEQ				.42	.27	3.41**
Step 3	1.49	.01	1, 52			
T1 PDST: AP × T2 NLEQ				.17	.09	1.22
	Model $R^2 = .75$, F (4,52) = 39.07, $p < .001$					
Achievement negative structure ($n = 41$)						
Step 1	87.87***	.69	1, 39			
T1 BDI-II				.83	.83	9.37***
Step 2	7.42**	.09	2, 37			
T1 PDST: AN				−.14	−.09	−.85
T2 NLEQ				.54	.35	3.85***
Step 3	5.01*	.03	1, 36			
T1 PDST: AN × T2 NLEQ				−.35	−.18	−2.24*
	Model $R^2 = .81$, F (4, 36) = 37.72, $p < .001$					

Note: BDI-II = Beck Depression Inventory-II; NLEQ = Negative Life Events Questionnaire; PDST = Psychological Distance Scaling Task; IP = Interpersonal Positive Content; IN = Interpersonal Negative Content; AP = Achievement Positive Content; AN = Achievement Negative Content.
*$p < .05$; **$p < .01$; ***$p < .001$.

possibility that interstimulus distances from the PDST may represent enduring vulnerability factors for depression, according to Ingram and colleagues' (1998) definition.

Likewise, consistent with diathesis-stress hypotheses, self-structure interconnectedness for interpersonal negative and achievement negative content interacted with negative life events in the expected directions to predict self-reported depressive symptoms, controlling for baseline dysphoria (i.e., more tightly interconnected negative self-structures was associated with greater depressive reactions in response to greater stress). These findings are in line with other diathesis-stress results for cognitive self-schema content (e.g., Hankin et al., 2008; Klocek et al., 1997; Lewinsohn et al., 2001). The results of the current study expand our understanding of how cognitive factors may contribute to vulnerability to depression and provide support for the diathesis-stress component of Beck's (1967) cognitive theory. Individuals who possess a highly organized or consolidated negative sense of self may be particularly vulnerable to depression when life stressors occur that are similar to those which helped to create these self-structures. In the face of negative life events, aspects of these schematic structures may become activated. In the case of a highly consolidated negative self-structure (i.e., smaller interstimulus distances), this activation may spread rapidly to other associated negative content (Bower, 1981), triggering negative information processing biases in memory and attention. At the same time, our results suggest that a highly interconnected sense of self in the domain of interpersonal positive, is not protective against depression on its own (individuals with this form of organization were as likely to have higher levels of depression as those with a diffusely interconnected interpersonal positive structure in the presence of high stress). This suggests that both positive and negative structure may independently contribute to negative reactions to stress, rather than the presence of a more adaptive structure helping to buffer individuals from stress's adverse effects (Clark et al., 1999).

The current results suggest that self-schema structures may confer vulnerability to depression. In contrast to many other proposed cognitive vulnerability factors which rely on self-report questionnaires, the current paradigm provides a metric and method for assessing cognitive organization of the self-system. How these schema structures develop and change over time, what types of experiences create maladaptive cognitive organization, which types of stressors activate particular self-structures and the extent to which they are modifiable are important questions for future research.

The origins of the self-schema, as Beck suggests, lie in early life experience. The attachment relationship in infancy and childhood likely sets the groundwork for an organized, cohesive set of memories and emotions (Ingram, 2003). Self-schemas, if viewed in this way, may be akin to internal working models of attachment (IWMs) as defined by Bowlby (1980). In the face of adverse early conditions, including neglect, abuse, trauma, harsh or critical parenting, or witness to domestic violence, children may develop a highly interrelated set of memories, beliefs, and emotions about their own self-worth and their safety in the world—their self-schema or IWMs. As they grow, subsequent life events in important areas to the self may activate these latent schemas, triggering associated beliefs, emotions, and information processing biases in attention and memory (Riskind & Alloy, 2006). For those individuals whose self-schemas focus on the importance of relationships and connectedness, life events in an interpersonal domain such as rejection may be particularly devastating. In contrast, for those who are more achievement-focused in their self-system, life events related to failure or disappointment may be the ones that interact to produce a depressive episode (cf. Beck, 1983). At this point, many of these suggestions are merely theoretical and speculative and need to be tested empirically. Future research should attempt to link early parenting and attachment experiences with the development of the self-schema to elucidate the mechanism(s) related to this fundamentally important cognitive feature of self.

Limitations and Future Directions

As with many studies, there are also limitations to the current investigation. To begin, our sample consisted of a small number of undergraduate students, which precluded an examination of gender, age, and ethnicity as moderators of the above models. As well, there may be important predictors of attrition that were not assessed in the current study and/or were undetectable due to our limited statistical power. Adolescents and young adults who attend university may differ in important ways from those who do not, and may consequently show differences in cognitive vulnerability, exposure to stressful life events and dysphoria (e.g., Coyne, 1994). Notwithstanding this criticism, analogue samples are appropriate to study in their own right, given the reasonable continuity of depression between student and clinical samples and the incidence of depression for individuals in this age range (e.g., Flett, Vredenburg, & Krames, 1997; Hankin et al., 2004). Future replication is needed to corroborate and extend these findings.

The assessment of self-schema structures represents a strength of the current study, but there are limitations associated with its measurement. Although the PDST provides an innovative method for examining the conceptual organization of the self-system, it does rely on participants' self-report of endorsement and relative positioning of words to provide the information for the interstimulus distance calculations. On the other hand, the metric derived from this task is less face valid and more complex than that of many other self-report questionnaires (i.e., interstimulus distances vs. sum/average scores), making it difficult for participants to show a response bias. All study data were, in fact, collected from students' self-report. Given the potential for biases associated with using the same informant and method for assessing the main constructs of this study, an important next step would be to use multiple methods (e.g., information processing paradigms, Gotlib & Joormann, 2010; contextual life stress interviews, Monroe, 2008) and multiple informants (e.g., roommates, friends, parents) to assess the variables of interest. Despite this limitation, the current study is the first to examine self-schema structure in a diathesis-stress framework and provides a useful starting point for future research.

The relationship between cognitive vulnerability, negative life events and depression is likely complex and not necessarily unidirectional (Hankin & Abramson, 2001). In the current study, it may have been the case that elevations in depressotypic self-schema structure preceded and contributed to the occurrence of life stressors—an effect called *stress generation* (Hammen, 1991). Future studies should examine the occurrence of life stressors using more frequent measurement intervals, such as daily diary or multiwave designs, to examine the direction and nature of relationship between the presence of these stressors, cognitive vulnerability, and mood fluctuations (e.g., Hankin, 2008a; Hankin et al., 2008).

Conclusion

Taken together, these results suggest that cognitive structure may be a relatively stable vulnerability factor that interacts with negative life events to predict self-reported symptoms of depression. Future research should examine whether the interaction of cognitive structure and life events prospectively predicts the onset of clinically significant major depressive episodes. Preventing depression before its first onset has the potential to alleviate the economic and social burden of this devastating disorder (Murray & Lopez, 1996). A more thorough examination of the development of cognitive self-structure over time, and the process of consolidation as a risk factor for depression, may help in the development and implementation of effective targeted intervention and prevention programs (see Dozois & Dobson, 2004).

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