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Transactional Relationships among Cognitive Vulnerabilities, Stressors, and Depressive Symptoms in Adolescence

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Abstract The transactional cognitive vulnerability to stress model Hankin & Abramson (Psychological Bulletin, 127:773–796, 2001) extends the traditional diathesis-stress model by proposing that the relationships among cognitions, depressive symptoms, and stressors are dynamic and bidirectional. In this study three different pathways among these variables were assessed simultaneously: (1) cognitive vulnerabilities and stressors as predictors of depressive symptoms (vulnerability model), (2) depressive symptoms and cognitive vulnerabilities as predictors of stressors (stress generation model), and (3) depressive symptoms and stressors as predictors of cognitive vulnerabilities (consequence model). A fully cross-lagged design panel was employed with 1,187 adolescents (545 girls and 642 boys, Mean Age= 13.42 years) who were assessed at two time points separated by 6 months. They completed measures of cognitive vulnerabilities (maladaptive schema domains and negative inferential style), stressors, and depressive symptoms. Inferential style and schemas of the disconnection and rejection domain predicted prospective increases in depressive symptoms. Initial levels of depressive symptoms and most cognitive vulnerabilities predicted greater stress generation. Initial levels of stressors and depressive symptoms predicted an increase in negative inferential style and maladaptive schema domains over time. These bidirectional relationships were mostly similar for boys and girls, although there were a few gender differences. The findings support a transactional model with reciprocal relationships among stress, depressive symptoms, and cognitive vulnerabilities. Transactional implications for depression interventions among adolescents are discussed.

Keywords Depression · Inferential style · Maladaptive schemas · Stress generation · Consequence hypothesis · Adolescents

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During adolescence the prevalence of depression increases dramatically (Avenevoli et al. 2008) whilst sex differences in both depressive symptoms and disorders emerge (Hankin et al. 1998). These changes make adolescence a critical period to study the development of depression. Although multiple factors contribute to the development of depression, cognitive styles and stress provide key elements to understand both the increase of depression in adolescence and the higher rates of depression among adolescent girls. Traditional cognitive vulnerability models have focused on the role of both stress and cognitive styles as precursors of depressive symptoms. However, transactional models (e.g. Cicchetti and Schneider-Rosen 1984; Hankin and Abramson 2001) propose that relationships among stress, cognitive styles, and depressive symptoms may be reciprocal. The current study focuses on these reciprocal transactions among stress, cognitive vulnerabilities, and depressive symptoms in adolescents and explores whether these hypothesized transactional associations vary by gender.

Cognitive Vulnerabilities to Depression

Cognitive models of depression propose that certain negative cognitive styles act as vulnerability factors for depression, particularly when interacting with negative life events.

Beck's model of cognitive therapy (Beck 1983) and hopelessness theory (Abramson et al. 1989) are two of the most influential models to explain the development and maintenance of depression.

According to Beck's model, cognitive vulnerability to depression consists of cognitive schemas involving dysfunctional beliefs about the world, relationships with others and oneself (Beck 1983). Young and colleagues extended the work of Beck and identified a variety of early maladaptive schemas that are hypothesized to underlie several forms of psychopathology, including depression (Young 1999; Young et al. 2003).

Maladaptive schemas are defined as broad, dysfunctional, and pervasive patterns consisting of memories, emotions, cognitions, and bodily sensations about oneself and relationships with others (Young et al. 2003). Previous studies have indicated that schemas belonging to the domains of disconnection and rejection and impaired autonomy are particularly predictive of depressive symptoms (Calvete et al. 2005; Cámara and Calvete 2012; Eberhart et al. 2011; Lumley and Harkness 2007; Roelofs et al. 2011; Welburn et al. 2002). The schemas in the domain of *disconnection and rejection* involve the expectation that one's needs for security, acceptance, and respect will not be fulfilled in a predictable way, whereas the schemas in the domain of *impaired autonomy* consist of expectations about oneself and the environment that interfere with one's perceived capacity to function independently or perform successfully. Recent studies indicate that the results on maladaptive schemas and psychopathology can be extended to samples of adolescents (e.g., Bosmans et al. 2010; Muris 2006; Roelofs et al. 2011).

According to the hopelessness theory (Abramson et al. 1989), the depressogenic vulnerability style consists of negative inferences that include (a) the tendency to attribute negative events to internal, global, and stable causes, (b) the tendency to perceive negative events as having important negative consequences that will affect many areas of one's life, and (c) the tendency to draw negative inferences about the self following negative events. Several prospective studies have provided support for this theory in children and adolescents, showing that negative inferences alone and interacting with stressors predict increases in depressive symptoms (for reviews see Abela and Hankin 2008; Lakdawalla et al. 2007).

Bidirectional Relationships Among Cognitive Vulnerabilities, Stressors, and Depressive Symptoms

The transactional cognitive vulnerability to stress model (Hankin and Abramson 2001) extends the traditional diathesis-stress model by hypothesizing that the relationships among cognitions, depressive symptoms, and stressors are dynamic and bidirectional. In particular, this theory posits that cognitive styles act as vulnerability factors for the development of depression but other factors such as depressive mood and stressors "can initiate a causal chain that leads to more stressors, may worsen cognitive vulnerability, and ultimately contribute to even greater increases in depressive symptoms over time" (Hankin et al. 2008, pp. 316–317). Thus, this model emphasizes the bidirectional relationships among cognitions, stressors and depressive symptoms, suggesting that people often fall into a spiral where all these factors mutually influence each other. However, as most of the studies have focused on studying to what extent and under what circumstances stressors and cognitive styles predict depressive symptoms, the alternative relationships among these variables have been relatively neglected (Lagrange et al. 2011). These less explored paths include two areas of research: the stress generation (e.g., Daley et al. 1997; Hammen 1991) and the consequence models (e.g., Lagrange et al. 2011; Lewinsohn et al. 1981), which are described below.

Stress Generation

The stress generation hypothesis refers to the fact that depressed individuals may contribute to the generation of additional stress in their lives (Hammen 1991). As a consequence, previous levels of depression predict increases in future levels of stressors and these in turn contribute to perpetuate depression (see reviews by Hammen 2005; Liu and Alloy 2010). The hypothesis is specific for dependent (or controllable) events. A number of studies have supported the existence of the stress generation effect in children and adolescents (e.g., Calvete 2011b; Gibb and Hanley 2010; Hankin et al. 2007; Shih et al. 2009). There are several explanations for this effect. For instance, depressive symptoms may lead children and adolescents to school failure. Also their tendency to isolation may make them less attractive to their peers, resulting, as a consequence, in experiences of rejection by others.

The stress generation hypothesis also implies that cognitive vulnerabilities could contribute to generate stress. This way, for instance, adolescents who endorse failure expectancies would tend to experience more failures, and adolescents who think that they need to be approved by all may behave in ways that contribute to being rejected by others. However, the study of cognitive vulnerabilities as precursors of stress has been relatively scarce. Most of the evidence corresponds to cognitive schemas. Namely, a number of schemas in the interpersonal domain, such as dependency, sociotropy, and reassurance seeking, have been found to contribute to generate stress (Calvete 2011a; Daley et al. 1997; Eberhart and Hammen 2010; Lee et al. 2010; Shih 2006). Moreover, Eberhart et al. (2011) found that several

maladaptive schemas (e.g., emotional deprivation, mistrust, and failure) predicted interpersonal stress.

In contrast, inferential style as predictor of stress has received less attention and the results are mixed. Whereas some studies have found that negative inferential style predicts stress in samples of adolescents (Calvete 2011b) and children of parents with a history of clinical depression (Shih et al. 2009), Gibb et al. (2006) failed to find this effect. Thus, overall, the study of cognitive vulnerabilities as generators of stress is still limited, particularly for inferential style.

Consequence of Depression Model

Lewinsohn and colleagues (1981) proposed the scar hypothesis, which states that experiencing depression can worsen individuals' depression vulnerabilities, including cognitive risks. This way, for instance, an adolescent who experiences depression may develop a hopeless view of the world and his/her future. A number of studies have examined the scar hypothesis in samples of adolescents after a depressive episode with mixed results. For instance, Rohde et al. (1994) found several psychosocial scars in adolescents after the depressive episode and suggested that early-onset depression may impact adolescents more severely than adults. In contrast, Beevers et al. (2007) failed to find support for the scar hypothesis with other variables including negative emotionality, rumination, and self-esteem.

As an extension of the scar hypothesis, a growing number of studies have found that depressive symptoms predict a worsening of cognitive vulnerabilities among nonreferred samples of adolescents, including negative inferences (Calvete 2011b; Garber et al. 2002; McCarty et al. 2007; Mezulis et al. 2010; Stewart et al. 2004) and cognitions that involve a negative self-view (McCarty et al. 2007; McGrath and Repetti 2002; Shahar et al. 2004; Stewart et al. 2004; Tilghman-Osborne et al. 2008). Moreover, stressful circumstances can also contribute to the deterioration of individuals' cognitive style (e.g., Auerbach et al. 2010; Gibb et al. 2006; Hankin et al. 2008). These studies suggest that negative life events such as school failure or peer rejection can lead to a negative view of oneself.

Overview of the Present Study

The present study aims to expand the extant research base by examining the bidirectional relationships among cognitive vulnerabilities, stressors, and depressive symptoms over time. In contrast with the majority of the previous studies, which have examined only some of these relationships, we assessed three different pathways among these variables simultaneously: (1) cognitive vulnerabilities and stressors as predictors of depressive symptoms (vulnerability model), (2) depressive symptoms and cognitive vulnerabilities as predictors of stressors (stress generation model), and (3) depressive symptoms and stressors as predictors of cognitive vulnerabilities (consequence model). Furthermore, whereas most of the previous studies on stress generation and the consequence model have examined only one cognitive vulnerability, we integrated in the same study two of the best-known cognitive vulnerabilities for depression: maladaptive cognitive schemas and negative inferential style.

Finally, we examined whether the above pathways were moderated by sex. There is some indication that some pathways could be more characteristics of girls than of boys. For instance, there is some evidence to support the hypothesis that stress generation is stronger in girls than boys, although the results have been mixed (e.g., Gibb and Hanley 2010; Jones et al. 2001; Hankin et al. 2007; Shih 2006). Moreover, some studies have found support for the consequence model only in girls (Nolen-Hoeksema et al. 2007; Shahar et al. 2004). However, sex differences have not been examined in all the studies, and some of the above-mentioned studies were conducted in samples of only girls (e.g., Eberhart et al. 2011; Rudolph et al. 2009). Therefore, it is important that research examine sex differences in the pathways among cognitive vulnerabilities, stressors, and depressive symptoms.

Method

Participants

The total number of youth available for participation was 1,311 adolescents (588 girls and 723 boys), who were high school students from 51 classrooms of 8 educational centers of Bizkaia (Spain). The schools were selected randomly and included both public and private educational centers. Adolescents aged 13–17 were selected for this study because at this stage sex differences in depression have already emerged (Hankin et al. 1998). The measurements were taken at the beginning of the school year (T1) and again 6 months later (T2). One-hundred twenty-four adolescents did not complete the measurements at either time (participation rate: 90.54 %); the lack of participation was due almost entirely to sickness or absence. The attrition rate included also participants who did not respond to some of the questionnaires and were therefore eliminated from the study. Thus, the final sample was comprised of 1,187 participants (545 girls and 642 boys), with a mean age at the beginning of the study of 13.42 years (SD=1.30). A series of t tests was conducted to determine whether participating adolescents differed from nonparticipating on any of the variables included in this study. None of these analyses

was significant. The socio-economic levels were determined applying the criteria recommended by the Spanish Society of Epidemiology and Family and Community Medicine (2000) and from the information provided by the school staff about parental education and income. The socioeconomic levels were represented with the following distribution: 19.1 % low, 17.5 % low-medium, 25.8 % medium, 18.7 % high-medium, and 18.6 % high levels.

Measures

The Adolescent Perceived Events Scale (APES; Compas et al. 1987). In this study, a Spanish adaptation of the short version of the APES employed by Hankin et al. (2001) was used. This version disregards events that can be confused with psychopathology. Because the primary interests in this study were dependent stressors, the scale was scored by calculating the total number of dependent events experienced (e.g., arguments or problems with a friend, getting bad grades on progress reports). A total of 17 events were included in the dependent stressors category. A previous study indicated excellent inter-judges reliability for this classification (Calvete 2011a). For each event, participants indicated whether it had occurred in the past 6 months. All participants had experienced at least one stressor.

The Adolescent Cognitive Style Questionnaire (ACSQ; Hankin and Abramson 2002) is based on the hopelessness theory model (Abramson et al. 1989). It assesses cognitive vulnerability, including negative inferences about the causes of negative events, their consequences, and their implications for the self. The questionnaire presents hypothetical negative scenarios (3 of an interpersonal nature and 3 related to achievement or performance) that are relevant in adolescence. In this study we used the Spanish version of the ACSQ, which has shown good psychometric properties (Calvete et al. 2008). The following are examples of some of the scenarios used: "You want to have a boyfriend/girlfriend but you don't have one" and "You have a big fight with your parents". Adolescents are asked to imagine each scenario and indicate to what extent the cause of the event is internal, stable, and global, the likelihood of future negative consequences due to the event, and the extent to which they believe that what happened shows that they failed as a person. The response scale ranges from 1 to 7, with higher values indicating that the adolescent displays a more negative cognitive style. Various longitudinal studies have demonstrated the validity and reliability of the ACSQ as a measure of inferential style both in the original version (Cole et al. 2008; Hankin 2008) and in the Spanish version (Calvete et al. 2008). In the present study, the total score of inferential style was used. The alpha coefficient was 0.90 at T1 and 0.91 at T2.

Cognitive schemas were assessed by the Young Schema Questionnaire-Short Form (YSQ-SF, Young and Brown 1994). The YSQ-SF consists of 75 items and assesses 15 cognitive schemas, which are grouped into five schema domains. Participants are asked to rate items using a 6-point scale from 1 (*completely untrue of me)* to 6 *(describes me perfectly*). In this study the YSQ-SF was used to assess two schema domains that have been found to be related to depression in previous studies. The disconnection and rejection domain included the following schemas: *Abandonment,* which refers to the perception that significant others will not go on giving emotional support because they will abandon the person in favor of someone better (e.g., "I need other people so much that I worry about losing them"); *abuse*, which describes the expectation that others will hurt, abuse, humiliate, or take advantage, and usually involves the belief that the harm is intentional or the result of negligence (e.g., "I feel that people will take advantage of me"); *defectiveness or Shame*, which describes the feeling that one is defective, unwanted, or invalid in significant aspects (e.g., "I'm unworthy of the love, attention, and respect of others"); and *emotional deprivation, which* involves the belief that others will not adequately meet one's need of emotional support (e.g., "For much of my life, I haven't felt that I am special to someone"). The impaired autonomy domain included *vulnerability to harm,* which involves an exaggerated fear that random catastrophe could strike at any time and that one will be unable to prevent it (e.g., "I worry about being attacked") and *failure,* which describes the belief that one has failed, will inevitably fail, or is fundamentally inadequate relative to one's peers, in areas of achievement (e.g., "I'm incompetent when it comes to achievement"). The original version of the SQ-SF has obtained good psychometric properties (Hoffart et al. 2005) and, similarly, the Spanish version of the SQ-SF has showed good validity and reliability (Calvete et al. 2005). The alpha coefficients in this study were 0.89 and 0.81 for disconnection and rejection and for impaired autonomy schema domains at T1, and 0.91 and 0.84 at T2.

Depressive symptoms were assessed with the Center for Epidemiological Studies Depression Scale (CES-D; Radloff 1977). The CES-D consists of 20 statements rated on a 4-point response scale, ranging from 0 (*rarely or none of the time*) to 3 (*most or all of the time*), which have to be responded in reference to the last month. The original version of the CES-D has obtained good reliability and validity (Radloff 1977). Furthermore, previous research with the Spanish version of the CES-D has confirmed its factorial structure and has showed excellent reliability indexes (Calvete and Cardeñoso 1999). Scores greater than 16 indicate mild depressed mood or greater, greater than 23 indicate moderate depressed mood or greater, and greater than 28 indicate severe depressed mood consistent with major

depression (Radloff 1991). The alpha coefficients in this study were 0.84 and 0.88 at T1 and T2, respectively.

Procedure

Data were collected at two measurement occasions spaced 6 months apart: T1 and T2. All the questionnaires were completed at both times. After presenting the project, the Institutional Review Board of University of Deusto approved this study. High schools were contacted first by telephone and the study was explained in order to get their permission. Next, the parents were notified and given the option of refusing to allow their child's participation. Responses were anonymous in order to promote honesty, and participation was voluntary. None of the adolescents refused to participate in the study. The adolescents filled in the questionnaires in their classrooms. Participants were encouraged to ask questions if they had any trouble answering the items. The questionnaires took between 45 and 60 min to complete.

Results

Descriptive Statistics and Correlations between Variables

The prevalence of mild depressed mood symptomatology (cutoff score on the CES-D >16) was 22.1 % at T1 (28 % in girls and 17.2 % in boys) and 17.1 % at T2 (19.6 % in girls and 14.8 % in boys). The prevalence of moderate depressed mood (cutoff score >23) was 6.9 % at T1 (9.2 % in girls and 5 % in boys) and 6.6 % at T2 (7.9 % in girls and 5.2 % in boys). The prevalence of severe depressed mood (cutoff score >28) was 2.5 % at T1 (3.7 % in girls and 1.6 % in boys) and 3.3 % at T2 (3.8 % in girls and 2.5 % in boys).

Table 1 displays the correlation coefficients among all the variables of the study, as well as the means and standard deviations for T1 and T2. As can be seen, all of the coefficients were statistically significant and several of them were high. The pattern of coefficients between T1 variables was very similar to the pattern of coefficients between T2 variables.

Reciprocal Relationships Among Depressive Symptoms, Cognitive Vulnerabilities and Stressors

General Data Analytic Strategy A cross-lagged design panel was employed. This type of design provides information about the strength of the temporal association between variables. The general model included measures of depressive symptoms, inferential style, maladaptive schemas, and number of stressors at T1 and T2. A model was specified in which: (a) T1 depressive symptoms, inferential style, disconnection and rejection schemas, impaired autonomy schemas, and stressors predicted their T2 counterpart (i.e., autoregressive paths); (b) T1 inferential style, disconnection and rejection schemas, impaired autonomy schemas, and stressors predicted T2 depressive symptoms (i.e., vulnerability model); (c) T1 depressive symptoms, inferential style, disconnection and rejection schemas, and impaired autonomy schemas predicted T2 stressors (i.e., stress generation), and (d) T1 depressive symptoms and stressors predicted T2 inferential style, disconnection and rejection schemas, and impaired autonomy schemas (i.e., consequence model). Whereas the autoregressive paths provide information about the relative stability of a construct, the paths measured across latent variables provide information about the degree to which one variable is a stronger temporal predictor of the other.

The models were tested via maximum likelihood estimation with LISREL 8.8 (Jöreskog and Sörbom 2006). Following the recommendations of (Hu and Bentler 1999), goodness of fit was assessed by the comparative fit index (CFI; values of 0.95 or greater indicate that the model adequately fits the data), the root mean squared error of approximation (RMSEA; values of 0.06 or less indicate that the model adequately fits the data), and the standardized root-mean-square residual (SRMR; values of 0.08 or less indicate that the model adequately fits the data). We used three item parcels as indicators of each latent variable. The use of parcels has several advantages. It reduces the number of parameters of the model, the indicator-to-subject ratio, the likelihood of correlated residuals and dual factor loading, and the sources of sampling error (Jöreskog and Sörbom 2006; Little et al. 2006). Thus, the model included 10 latent variables and 30 indicators. The scale of each construct was set by fixing the latent variance to 1 because this method is adequate when the manifest variables are measured on different scales (Little et al. 2006). In addition, error terms of the same variable assessed on different occasions were conceptualized as correlated with each other because of the assumption that factors contributing to measurement error in any specific variable will be consistent across measure occasions (Martens and Haase 2006).

First, a preliminary confirmatory factor analysis indicated the appropriateness of the measurement model and that the factor loadings were significantly different from zero. Next, the hypothesized structural model was tested. The fit indexes were excellent for the model, $\chi^2(256, N=1187)=1089$, RMSEA=0.052 (90 % CI: 0.049; 0.056), CFI=0.99, NNFI=0.98, SRMR=0.059. Table 2 displays the coefficients. All the autoregressive effects were statistically significant. All T1 variables, except impaired autonomy schemas, predicted T2 depressive symptoms (i.e., vulnerability model). T1 depressive symptoms, negative inferential style, and

Table 1 Correlation coefficients between the variables of the study

	1	2	3	4	5	6	7	8	9	10	M	SD
1.T1 depressive symptoms	1										12.64	5.68
2. T1 stressors	0.36**	1									9.44	3.90
3. T1 disconnection and rejection	0.58**	0.37**	1								46.12	16.69
4. T1 impaired autonomy	0.51**	0.36**	0.70**	1							24.73	9.46
5. T1 inferential style	0.34**	0.28**	0.43**	0.32**	1						104.39	29.03
6. T2 depressive symptoms	0.59**	0.21**	0.46**	0.40**	0.31**	1					11.56	5.87
7. T2 stressors	0.29**	0.34**	0.37**	0.32**	0.24**	0.47**	1				10.99	5.20
8. T2 disconnection and rejection	0.44**	0.33**	0.64**	0.49**	0.34**	0.59**	0.47**	1			43.98	17.27
9. T2 impaired autonomy	0.42**	0.34**	0.52**	0.65**	0.28**	0.53**	0.44**	0.75**	1		23.27	9.62
10. T2 inferential style	0.32**	0.22**	0.38**	0.29**	0.58**	0.42**	0.39**	0.47**	0.40**	1	105.07	30.76

**$p<0.001$

disconnection and rejection schemas predicted T2 stressors (i.e., stress generation model). Finally, the consequence hypothesis was fully confirmed, with both T1 stressors and depressive symptoms predicting all the cognitive vulnerabilities. The percentages of variance accounted for by the model were 0.47, 0.44, 0.47, 0.50, and 0.57, for T2 stressors, depressive symptoms, inferential style, disconnection and rejection schemas, and impaired autonomy schemas. Figure 1 displays the significant cross-lagged paths of the model.

Table 2 Unstandardized coefficients of the model

	Total sample N=1187	*Girls n=545*	*Boys n=642*
Auto-regressive paths			
T1 stressors→T2 stressors	0.76 (0.06)**	0.80(0.09)**	0.72(0.07)**
T1 depressive symptoms→T2 depressive symptoms	0.66 (0.06)**	*1.03(0.11)***	*0.39(0.07)***
T1 inferential style→T2 inferential style	0.82 (0.05) **	0.89(0.07)**	0.76(0.06)**
T1 disconnection schemas→T2 disconnection schemas	0.89(0.06)**	0.86(0.09)**	0.89(0.08)**
T1 autonomy schemas→T2 autonomy schemas	0.96(0.06)**	*1.11(0.10)***	*0.83(0.08)***
Cross-lagged predictors of depressive symptoms			
T1 stressors→T2 depressive symptoms	0.10(0.04)	0.11(0.07)	0.09(0.06)
T1 inferential style→T2 depressive symptoms	0.11(0.04)*	0.10(0.06)	0.12(0.06)*
T1 disconnection schemas→T2 depressive symptoms	0.19(0.08)**	*0.02(0.11)*	*0.37 (0.12)*n*
T1 autonomy schemas→T2 depressive symptoms	−0.02(0.07)	−0.07(0.10)	−0.05(0.11)
Cross-lagged predictors of stress			
T1 depressive symptoms→T2 stressors	0.11(0.06)*	0.18(0.08)*	0.08(0.07)
T1 inferential style→T2 stressors	0.12(0.04)**	0.13(0.06)*	0.10 (0.06)
T1 disconnection schemas→T2 stressors	0.13(0.06)*	0.14(0.09)	0.16(0.08)*
T1 autonomy schemas→T2 stressors	0.01(0.08)	0.09(0.10)	−0.03(0.11)
Cross-lagged predictors of inferential style			
T1 stressors→T2 inferential style	0.10(0.04)*	0.06(0.06)	0.12 (0.05)*
T1 depressive symptoms→T2 inferential style	0.16(0.04)**	0.25(0.06)**	0.12(0.05)**
Cross-lagged predictors of the disconnection and rejection schema domain			
T1 stressors→T2 disconnection schemas	0.19(0.04)**	0.07(0.06)	0.18(0.06)*
T1 depressive symptoms→T2 disconnection schemas	0.10(0.05)*	0.16(0.08)*	-0.01(0.07)
Cross-lagged predictors of the impaired autonomy schema domain			
T1 stressors→T2 autonomy schemas	0.23(0.05)**	0.06(0.07)	0.27(0.06)**
T1 depressive symptoms→T2 autonomy schemas	0.20(0.05)**	0.18(0.07)**	0.14(0.07)*

* $p<0.05$, ** $p<0.001$. Coefficients in italic were significantly different for boys and girls at $p<0.01$

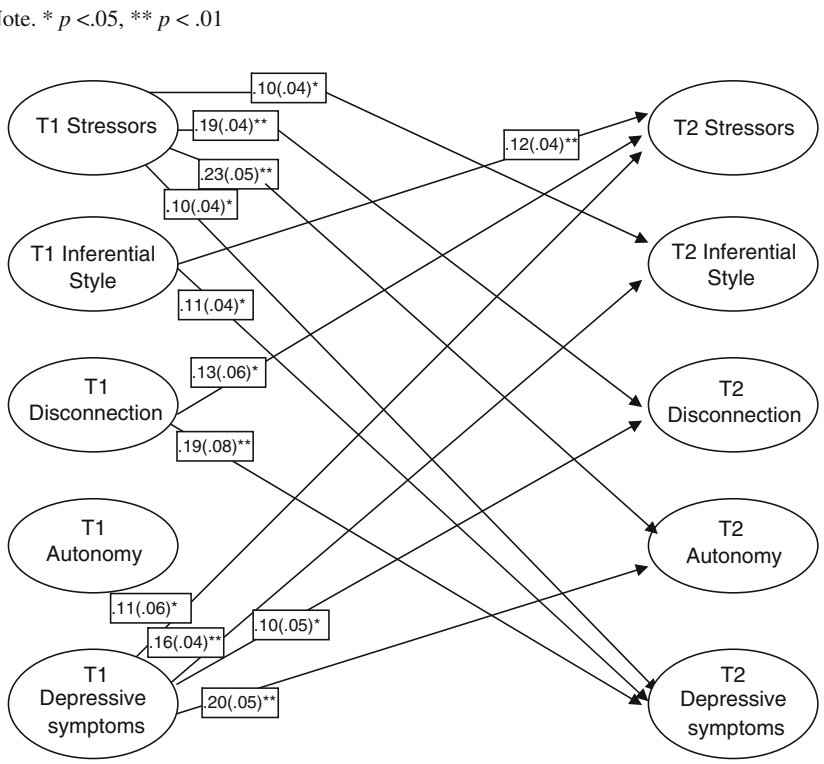

Fig. 1 Cross-lagged paths among stressors, inferential styles, maladaptive schemas, and depressive symptoms. Note. * $p<0.05$, ** $p<0.01$

Sex Differences in the Model The next step was to examine sex differences in the above pathways. Adolescent girls scored higher on depressive symptoms and maladaptive schemas, both at T1 and T2, whereas adolescent boys scored slightly higher on stressors at T2 (Table 3). There were no significant differences in inferential style.

We investigated whether the path coefficients of the model were equivalent across boys and girls through a multiple-group analysis. For this purpose, the following steps were carried out. First, we estimated the model for boys and girls separately. The fit indexes were adequate for boys, $\chi^2(256, N=642)=738$, RMSEA=0.054 (90 % CI: 0.050; 0.059), CFI=0.99, NNFI=0.98, SRMR=0.067, and for girls, $\chi^2(256, N=545)=666$, RMSEA=0.054 (90 % CI: 0.049; 0.059), CFI=0.99, NNFI=0.98, SRMR=0.056. The percentages of variance accounted for by the model were 0.44, 0.37, 0.43, 0.50, and 0.54, for T2 stressors, depressive symptoms, inferential style, disconnection and rejection schemas, and impaired autonomy schemas in boys, and 0.52, 0.55, 0.52, 0.50, and 0.61, for T2 stressors, depressive symptoms, inferential style, disconnection and rejection schemas, and impaired autonomy schemas in girls. Table 2 displays the coefficients in each subsample. Second, we tested the configural invariance of the model to demonstrate that the pattern of fixed and free parameters was equivalent across subsamples, $\chi^2(512, N=1187)=1403$, RMSEA=

Table 3 Sex differences in the variables of the study

	Girls $n=545$		Boys $n=642$		F(1, 1186)		
	Mean	SD	Mean	SD		p	d
T1 depressive symptoms	13.55	6.02	11.87	5.26	26.09	0.000	0.30
T2 depressive symptoms	12.13	6.05	11.05	5.60	10.17	0.001	0.20
T1 stressors	9.42	3.85	9.44	3.94	0.01	0.931	−0.01
T2 stressors	10.57	5.01	11.34	5.33	6.54	0.011	−0.15
T1 inferential style	103.72	28.41	104.97	29.56	0.53	0.466	−0.04
T2 inferential style	103.25	30.06	106.63	31.29	3.52	0.061	−0.11
T1 disconnection & rejection	48.37	16.27	44.20	16.83	18.40	0.000	0.25
T2 disconnection & rejection	45.73	16.21	42.50	18.01	10.21	0.001	0.19
T1 impaired autonomy	26.39	9.64	23.32	9.09	31.07	0.000	0.33
T2 impaired autonomy	24.44	9.71	22.28	9.44	14.72	0.000	0.23

0.054 (90 % CI: 0.051; 0.058), NNFI=0.98, CFI=0.99, SRMR=0.056. Finally, we tested the invariance of the paths linking the latent variables over time. This constriction increased χ^2 significantly, $\Delta\chi^2(19, N=1187)=46$, $p<0.001$, indicating that the overall pattern of paths was different between male and female adolescents. We examined each path separately to identify the differences. The different paths are indicated in the boxes in Table 2. The auto-regressive paths for depressive symptoms and for impaired autonomy schemas were higher in girls than in boys, $p<0.001$, indicating that these variables are more stable over time in girls than in boys. The path from T1 disconnection and rejection schemas to T2 depression was higher in adolescent boys than in adolescent girls, $p<0.05$. The rest of the paths were similar.

Discussion

Findings of this study demonstrate that the relationships among cognitive vulnerabilities, stressors, and depressive symptoms are reciprocal and much more complex than stated by the original stress-diathesis models. In particular, the study shows that depressive symptoms and cognitive vulnerabilities contribute to stress generation, and that stress and depressive symptoms contribute to worsening these cognitive vulnerabilities. We discuss these links in this dynamic transactional model, and then comment on how these processes (i.e., cognitive risks, stressors, and symptoms) can amplify each other over time to contribute to the surging rates of depression observed across adolescence.

Stress Generation

Regarding the stress generation process, the results are consistent with several previous studies that have demonstrated that initial levels of depressive symptoms generate stress (Calvete 2011a, 2011b; Gibb and Hanley 2010; Hankin et al. 2007; Shih et al. 2009) and add evidence to the less explored hypothesis that cognitive styles also can generate stress (Liu and Alloy 2010). In this study both disconnection and rejection schemas and inferential style predicted an increase in the number of stressors over time. This result is important because only a few studies had examined before the hypothesis that negative inferences can generate stress (Calvete 2011b; Hankin 2010; Shih et al. 2009). Moreover, only one previous study had examined maladaptive schemas as stress generators (Eberhart et al. 2011) and that study was based on a small sample of women. Thus, our research extends the knowledge base beyond the prior studies.

These results have theoretical implications because the role of maladaptive schemas as stress generators is consistent with the Schema Therapy model (Young et al. 2003). Young proposed that maladaptive schemas can influence the individuals' appraisals of the situations and their actions in such a way that the cognitions involved in the schemas are confirmed. Thus, for instance, if an adolescent endorses the mistrust/abuse schema, others' behavior will be interpreted suspiciously, increasing the probability of having conflicts with others. It is important to note that the impaired autonomy schemas did not predict an increase of stressors probably because the majority of the dependent events included in the APES are interpersonally focused and not specific for this schema domain.

Consequence Model

This study also adds information about the consequence model, which represents an extension of the scar hypothesis. The results indicate that initial levels of stressors and depressive symptoms contribute to increasing individuals' levels of cognitive risks for depression. Namely, the findings are consistent with those previous studies that showed that depressive symptoms can worsen inferential styles in non-clinical samples of adolescents (Calvete 2011b; Garber et al. 2002; McCarty et al. 2007; Mezulis et al. 2010; Stewart et al. 2004). Moreover, this is the first study to extend these findings to maladaptive schemas. The fact that depressive symptoms predict an increase in maladaptive schemas is also consistent with the view that depressive moods affect cognitions by increasing access to negative memories and interpretations about the self, relationships with others, and the world (Lerner and Keltner 2000; Persons and Miranda 1992).

Sex Differences

Finally, the current study examined sex differences in the paths among cognitive styles, stressors, and depressive symptoms. Consistent with several studies, adolescent girls scored higher on depression (see Hankin et al. 2008 for a review) and showed a higher degree of stability in depression over time than boys. As in previous research, they also displayed higher scores on both domains of maladaptive schemas (e.g., Calvete 2011a; Cámara and Calvete 2012; Welburn et al. 2002).

Furthermore, although the overall pattern of cross-lagged paths was very similar for boys and girls, some slight sex differences emerged for the role of maladaptive schemas. The disconnection and rejection schemas predicted depressive symptoms more strongly in boys than in girls. This finding is consistent with the results obtained by Cámara and Calvete (2012), who found that some maladaptive schemas were more strongly associated with depressive symptoms among men relative to women in a sample of college students.

In contrast with other studies, girls did not report higher scores on stressors than boys. However, the estimated model explained a higher percent of variance of T2 stressors in girls than in boys, and previous levels of depressive symptoms and inferential styles predicted an increase in stressors only in girls. This finding provides support for the original proposal that the process of stress generation is more specific for women and might explain women's higher risk of depression (Hammen 1991).

Strengths and Limitations of the Study

The pattern of findings needs to be considered in light of the strengths and weaknesses of the current study. The strengths include the use of a cross-lagged panel design that assesses the relative contribution of each latent variable to the prediction of the other variables in the model. This way, we examined three processes simultaneously (vulnerability, stress generation, and consequence) during adolescence, when rates of depression are dramatically increasing and there are considerable psychosocial stresses and challenges (Ge et al. 1994; Little and Garber 2005). The study is also one of the few studies that tested whether additional stressors are generated as a function of both negative cognitive styles and maladaptive schemas. Furthermore, this is the first study that examined the consequence model for early maladaptive schemas. A third strength of the study is that we investigated the degree to which the overall model, and each of the three processes, was invariant by sex. Prior research has examined sex differences in mean levels of cognitive risks and stressors (see Hankin et al. 2008, for review), but relatively few studies have examined whether sex affected the strength of association in these transactional processes over time (e.g., Calvete 2011a; Ge et al. 1994; Mezulis et al. 2010; Stone et al. 2010). Finally, the study was based on a relatively large sample of adolescents who represent a wide socioeconomic range. The use of a community sample is appropriate as most research suggests that depression among youth can be represented and conceptualized best as a continuous dimension, rather than discrete categories (Hankin et al. 2005). Moreover, use of a community sample suggests that the results are more generalizable to nonclinical populations than those obtained from clinic-referred samples (Goodman et al. 1997).

Still, there were several limitations that provide opportunities for future research. The main limitation of this study relates to the exclusive use of self-reported measures, which could contribute to enhanced associations among variables, due to the shared-methods variance (Kliewer et al. 1998). However, self-reports have considerable value, constitute a reliable approach to assess emotional states and cognitions, and are valid predictors of moods, emotions, and psychopathology (Haeffel and Howard 2010). Moreover, self-reports are probably the most valid method to assess affective symptoms from adolescence as adolescents have shown to be more accurate sources of information than parents and teachers regarding information about their inner states (DiBartolo et al. 1998). Still, it would be advisable for future studies to include diagnostic and contextual stress interviews, along with information processing assessments, to further examine the bidirectional associations among stress, depressive symptoms, and cognitions. A second limitation is that we included only two waves of assessment. Additional waves would be desirable to further examine the transactions and cascade effects among cognitions, depression and stressors over time. Finally, we included those schema domains that were most relevant for depression. Nevertheless future research should examine whether the consequence and stress generation operate for other schema domains such as other-directedness and overvigilance, which may be relevant for other psychological disorders (Young et al. 2003). Furthermore, future research could examine the scar and stress generation processes and the degree of match in the interpersonal and achievement domains. For instance, interpersonal stressors may worsen specifically interpersonal cognitive risks (e.g., disconnection and rejection schemas), whereas those achievement-related stressors may affect more severely performance and achievement cognitions (e.g., impaired autonomy schemas).

Implications

Despite these limitations, this is the first study that examined simultaneously the reciprocal relationships among cognitive styles, depressive symptoms, and stressors. These reciprocal relationships are consistent with the transactional cognitive vulnerability to stress model (Hankin and Abramson 2001) and with a developmental cascade model (Masten et al. 2005). In summary, the findings suggest that stressors and negative cognitive styles increase the likelihood of experiencing depressive symptoms and that once levels of depressive symptoms increase, these in turn increase the likelihood of new stressors and worsen cognitive vulnerabilities, which in a cascade effect, can increase the risk of depression over time. This perspective including bidirectional effects among variables is consistent also with those studies that integrate the stress generation model with the scar hypothesis (Beevers et al. 2007; Rohde et al. 1994). For instance, Rohde et al. (1994) included measures of life events as scars after an episode of major depression in adolescents. Thus, all these mechanisms can contribute to produce a snowball or cascade effect throughout adolescence, a developmental period where each of the involved elements experience substantial changes.

From the perspective of intervention, these findings have important implications as they contribute to explaining the

substantial continuity of depressive symptoms over time (Tram and Cole 2006). They also highlight the importance of early prevention, as once this complex and dynamic process among stress, cognitive vulnerability, and depressive symptoms initiates, the effects tend to accumulate and magnify over time (Hankin 2010). Appropriate timing and delivery of evidence-based preventions, such as cognitive-based programs (e.g., Gillham et al. 2008) to reduce the worsening of cognitive vulnerabilities, alongside interpersonal-based programs (e.g.,. Young and Mufson 2008) to reduce stressful interpersonal events that can cascade into deteriorating levels of cognitive vulnerability and increasing levels of depression, hold promise for breaking the dynamic, transactional, positive feedback loop that can perpetuate a vicious cycle of depressive symptoms, stressful events, and negative cognitions. Thus, the present study's findings emphasize the importance of appropriately timed interventions aimed at multiple facets of risk, including these complex dynamics among stress, cognitions and depression, to more effectively short-circuit the cascade effect of these processes that accumulate to contribute to increasing risk to depression development, stability, and recurrence over time.

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