

Sex Differences in Adolescent Depression: Stress Exposure and Reactivity Models

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Stress exposure and reactivity models were examined as explanations for why girls exhibit greater levels of depressive symptoms than boys. In a multiwave, longitudinal design, adolescents' depressive symptoms, alcohol usage, and occurrence of stressors were assessed at baseline, 6, and 12 months later ($N = 538$; 54.5% female; ages 13–18, average 14.9). Daily stressors were coded into developmentally salient domains using a modified contextual-threat approach. Girls reported more depressive symptoms and stressors in certain contexts (e.g., interpersonal) than boys. Sex differences in depression were partially explained by girls reporting more stressors, especially peer events. The longitudinal direction of effects between depression and stressors varied depending on the stressor domain. Girls reacted more strongly to stressors in the form of depression.

Adolescence has been characterized as a hallmark period of transition with numerous biological, social, and psychological challenges. Such difficulties frequently persist into adulthood and may have important long-term implications that forecast continued problems with physical and mental health and development. A considerable amount of theory and research points to enhanced difficulties for girls as they enter adolescence (Crick & Zahn-Waxler, 2003). Indeed, girls begin to exhibit more internalizing emotional problems, especially symptoms of depression, than boys starting in early adolescence and lasting throughout most of adulthood (Hankin & Abramson, 1999; Kuehner, 2003). However, despite this well-replicated finding, comparatively less research has explained the sex difference in depression during adolescence. As such, the primary purpose of the present study was to use data from a multiwave prospective study to test developmentally based explanations for why more girls than boys experience depression starting in adolescence. We examined both mediational and moderational models of how the frequency and type of stressors experienced by girls and boys predict depression.

Descriptive Timeline for the Development of the Sex Difference in Depression

More girls than boys experience depression (see Hankin & Abramson, 2001; Kuehner, 2003, for re-

views). Prospective research using community samples shows that more girls than boys exhibit depressive mood and symptoms (Angold, Erkanli, Silberg, Eaves, & Costello, 2002; Ge, Lorenz, Conger, Elder, & Simons, 1994; Twenge & Nolen-Hoeksema, 2002; Wade, Cairney, & Pevalin, 2002) and clinical depression (Costello, Mustillo, Erkanli, Keeler, & Angold, 2003; Hankin et al., 1998; Reinherz, Giaconia, Lefkowitz, Pakiz, & Frost, 1993) starting in early adolescence (around ages 12–13). Furthermore, this research reveals that the sex divergence in depressive symptoms and disorder becomes most dramatic in middle to late adolescence. Accordingly, early and middle adolescence are important and promising developmental periods to study potential explanations for the emergence and widening of the gap in the sex difference in depression.

Theoretical Models for the Sex Difference in Adolescent Depression

Various theorists have posited conceptual models to explain why more girls than boys become depressed in adolescence (e.g., Cyranowski, Frank, Young, & Shear, 2000; Hankin & Abramson, 2001; Nolen-Hoeksema & Girgus, 1994; Rudolph, 2002; Seiffge-Krenke & Stemmler, 2002). A common theme among these models is the increasingly stronger influence that negative life events, especially those in interpersonal contexts (e.g., peer, romantic, and family relationships), may have on general emotional and behavioral maladjustment and the development of depression specifically during adolescence.

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Prospective longitudinal research has shown that the overall number of negative life events increases with the transition from childhood into adolescence and parallels the emergence of the sex difference in depression (Ge et al., 1994). Stressors are associated concurrently and prospectively with depression in adolescence (Grant et al., 2003; McMahon, Grant, Compas, Thurm, & Ey, 2003).

Developmental theory and evidence highlight that interpersonal stressors become more prevalent and important in adolescence and may be more predictive of depression (Rudolph & Hammen, 1999; Rudolph, 2002; Wagner & Compas, 1990). Adolescents may experience interpersonal stressors more frequently because they transact more actively within their social environments as they transition from late childhood into adolescence and they select and create their social worlds (Boyce, Frank, Jensen, & MacArthur Foundation Research Network on Psychopathology and Development, 1998; Rudolph & Asher, 2000; Scarr, 1992).

Importantly for the present research, theory and evidence suggest that interpersonal and achievement types of events may be different for boys and girls starting in adolescence. Adolescent girls' relationships and friendships seem to be characterized by greater levels of intimacy, emotional support, and self-disclosure (Rose, 2002; Rose & Rudolph, 2006), whereas such relationships among boys tend to be grounded in companionship and shared activities (Maccoby, 1990). For girls compared with boys, close interpersonal relationships are more important for self-definition and identity (Gore, Aseltine, & Colten, 1993; Maccoby, 1990) and are used more as a source of emotional support (Buhrmester, 1996; Cross & Madson 1997). Such sex differences in the form and function of interpersonal relationships are amplified as youth progress through adolescence and the importance of the peer group grows in significance for youths' social and emotional experiences (Furman & Burhmester, 1985; Larson & Asmussen, 1991; Laursen, 1996).

Two distinct conceptual models involving stressors can be considered as an explanation for the sex difference in depression (see Hankin & Abramson, 1999; Rudolph, 2002). First, the mediational—stress exposure model states that girls experience more stressors than boys, and as a result, girls become more depressed. Second, according to the moderational—stress reactivity model, girls exhibit greater levels of depression than boys in response to stress. It is important to note that the mediational—stress exposure and moderational—stress reactivity models are not mutually exclusive or competing models

to account for the sex difference in depression. Either one or both models may help to explain why girls exhibit more depression than boys, albeit in potentially different ways.

Previous investigations have examined separate aspects of these models, although no research to date has studied prospectively both the stress exposure and reactivity model in terms of the different domains of stressors. Consistent with the mediation—stress exposure model, numerous studies have shown that adolescent girls report more stressors overall than boys (e.g., Allgood-Merten, Lewinsohn, & Hops, 1990; Davies & Windle, 1997; Ge et al., 1994; Graber et al., 1995). In terms of specific types of stressors, girls report more interpersonal stressors, including peers, romantic partners, and family members, whereas boys experience more achievement and self-relevant stressors (Gore et al., 1993; Larson & Ham, 1993; Leadbeater, Blatt, & Quinlan, 1995; Rudolph & Hammen, 1999; Rudolph, 2002; Towbes, Cohen, & Glyshaw, 1989; Wagner & Compas, 1990; Windle, 1992). The sex difference in adolescent depression is mediated, at least in part, by adolescent girls' greater exposure to interpersonal peer (Liu & Kaplan, 1999; Rudolph & Hammen, 1999; Rudolph, 2002) and family (Davies & Windle, 1997) stressors.

In addition, some evidence supports the moderational—stress reactivity model for stressors overall, although the findings are mixed. Some studies find that adolescent girls respond to general stressors with greater depression than boys (Achenbach, Howell, McConaughy, & Stanger, 1995; Ge et al., 1994; Ge, Conger, & Elder, 1996; Marcotte, Fortin, & Potvin, 2002; Rudolph, 2002; Schraedley, Gotlib, & Haywood, 1999), whereas others have not found a sex difference in stress reactivity (Burt, Cohen, & Bjorck, 1988; Cauce, Hannan, & Sargeant, 1992; Larson & Ham, 1993; Leadbeater, Kuperminc, Herzog, & Blatt, 1999; Wagner & Compas, 1990). Few studies have evaluated the moderational—stress reactivity model in terms of specific domains of stressors: Girls may respond in a more depressogenic manner than boys to interpersonal stressors (Goodyer & Altham, 1991; Leadbeater et al., 1995; Moran & Eckenrode, 1991), and boys may react more to school stressors than girls (Sund, Larsson, & Wichstram, 2003).

An important issue concerning the stress reactivity model is the hypothesis that boys and girls may express different forms of emotional distress after experiencing stressors. Some have suggested that the female preponderance of depression reflects a sex-linked way of expressing emotional distress in response to stressors, such that males may use more

alcohol or drugs, for example, whereas females express distress in the form of depressive symptoms (e.g., Zahn-Waxler, Crick, Shirtliff, & Woods, 2006; Crum, Brown, & Liang, 2001; Nolen-Hoeksema & Corte, 2003; Prescott, Aggen, & Kendler, 2000). To examine this hypothesis of emotional distress specificity in response to stressors, we included assessments of alcohol usage as well as levels of depressive symptoms.

Methodological and Design Considerations

We examined potential explanations for the sex difference in adolescent depression using a multiwave prospective study design to enable a more powerful test of the stress exposure and reactivity models than has been available in past research. We introduce methodological and design issues pertinent to examining our hypotheses.

Regarding stress measurement, most investigators have used either a normative (e.g., Coddington, 1972; Dohrenwend, Shrout, Link, Martin, & Skodol, 1986) or an appraisal (e.g., Compas, 1987; Lazarus & Folkman, 1984) approach (see Cohen & Park, 1992; Grant & McMahon, 2005). Appraisal-based methods highlight individual judgments of the stressfulness of events that account for subjective reactions to events. However, appraisal-based approaches and the sole use of self-report stressor checklists have some limitations. By using subjective ratings of the stressfulness of events, it is impossible to separate the actual, objective stressfulness of an event from an individual's subjective perception of the event because personality (Larsen, 1992) and depression (Hammen, 1992) are known to bias stress ratings (Duggal, Carlson, Sroufe, & Egeland, 2001). In contrast, normative-based methods emphasize independent, objective evaluations of the stressfulness of events that are separate from and not confounded by individual response biases. However, the typical normative-based approach also utilizes checklists, and as a result, this method may preclude a developmentally sensitive and contextually based assessment of stressors.

To provide a better assessment of stress, many investigators have advocated the use of "contextual threat" methods (e.g., Brown & Harris, 1978; Hammen, 1991) that provide ratings of stressors while factoring in the contextual significance of events for specific individuals. Contextual threat methods have been used successfully with youth (e.g., Adrian & Hammen, 1993; Goodyer & Altham, 1991; Rudolph & Hammen, 1999). However, contextual threat stress interviews, as typically used to date, rely on the in-

dividual to recall retrospectively when particular stressors occurred, and the recall window for events often is over an extended period of time (e.g., 1 year in Rudolph & Hammen, 1999). Despite their overall strengths, researchers using the contextual threat interview have recognized explicitly the potential limitation of this method as used to date: "conclusions cannot be drawn as to the direction of the relation" between stressors and depression when both are recalled at the same time point over the same span of time (Rudolph & Hammen, 1999, p. 675).

Most of the stress and depression research has been cross-sectional or two-time point prospective studies (see Adrian & Hammen, 1993, for an exception). However, developmental researchers have noted that cross-sectional, and even two-time point, designs are inadequate to examine issues of directionality and causality (e.g., Curran & Willoughby, 2003; Willett, Singer, & Martin, 1998). These methodologists emphasize the need for multiwave, prospective studies to provide more exacting and sophisticated tests of developmental hypotheses.

Given these methodological issues and recommendations, we used a novel and rigorous method to assess for stressors in a multiwave prospective design to advance understanding of etiological explanations for the sex difference in adolescent depression. Specifically, we utilized a 7-day diary methodology to assess the daily occurrence of stressors and then coded the events for threat levels and contextual domains of the events using procedures adapted from the contextual threat method. We applied these procedures to adolescents' daily reports of the negative events over a 1-week period in order to obtain a measure of the number of minimally threatening stressful events in various contextual domains. By using contextual-based coding of individual adolescents' reports of negative events recorded daily for a week, we sought to minimize concerns about the measurement of stress in a subjective manner, the retrospective recall of events over a long period of time, and the uncertain temporal relation between events and depressive symptoms. Furthermore, we used a three-wave prospective design. Depressive symptoms, alcohol usage, and the occurrence of stressors (assessed daily over 7 days) were measured at three time points over a 1-year period (at baseline, 6-, and 12-month intervals) in a community sample of early and middle adolescents (8th and 10th grades).

The Current Research

We hypothesized that: (1) consistent with the stress exposure model, girls, compared with boys,

would encounter more stressors overall and more interpersonal events specifically, and in turn, these additional stressors would mediate, at least in part, the sex difference in adolescent depression; and (2) consistent with the stress reactivity model, girls, compared with boys, would respond specifically with elevated levels of depressive symptoms, but not with alcohol usage, to overall stressors and interpersonal events, in particular.

Method

Overview of Study and Procedures

Data for this study came from a longitudinal study of the natural history of smoking among adolescents (for specific details about the study design, please see Mermelstein, Hedeker, Flay, & Shiffman, 2005). Briefly, the longitudinal study utilized a multimethod approach to assess adolescents at baseline, 6, and 12 months. The data collection modalities included extensive self-report paper-and-pencil questionnaire measures, in-person interviews, 7-day ecological momentary assessments via handheld computers, and a 7-day daily recording of events. For this study, we will focus on the data from the daily recordings of events through the diaries along with measures from the self-report questionnaires.

Participants

Eighth- and 10th-grade students from 18 Chicago suburban–metropolitan area schools served as participants. They were selected based on their smoking intentions and/or limited smoking experiences (e.g., <100 cigarettes in lifetime, susceptibility to smoking; Pierce, Choi, Gilpin, Farkas, & Merritt, 1996; see Diviak, Wahl, O’Keefe, Mermelstein, & Flay, 2006; Mermelstein et al., 2005, for details about participant selection, recruitment, and retention). Briefly, 713 youth were willing to participate (out of 1,457 invited), and 562 completed the baseline questionnaire. The 151 students who were willing to participate but did not complete the baseline visit were either sick/absent from school for their data collection and were unable to reschedule ($n = 25$; 16.6%), failed to bring signed parental consent forms ($n = 12$, 7.9%), or were turned away by research staff because enrollment in a particular schools was complete ($n = 114$, 75.5%). (As a result of the EMA portion of the study, we had an upper limit on the number of students who could be enrolled at a given school. Because we could not anticipate exactly how many students who agreed would actually show up, we “over-enrolled” at each

school, leading to the need to turn away some students). For this study, we examined data from 552 youth (98%) who provided complete depressive symptoms data at baseline. Rates of participation in the study decreased slightly at 6 months ($N = 521$, 94.4%) and at 12 months ($N = 506$, 91.6%). For the 552 youth, 54.5% were females; 17% were Hispanic; 4% were Asian or Pacific Islander; 5.5% African American; 87% White; and 3.5% bi- or multiracial. The average parental education for the sample was as follows: 29.9% completed high school or less, 16.9% completed some college, and 45.2% completed college or more. Socioeconomic status ranged from low to higher upper middle income (percentage of those categorized as low income ranged from 7% to 81%, average of 25.67%, based on demographic data from school districts from which students were recruited). With respect to family composition, 80% of children was living in two-parent households, 15% were living with a divorced/separated parent, 2% had a single, widowed parent, 2% were living with single parents (never married), and 1% were living with a parent and an unmarried partner.

Adolescents completed various self-report questionnaires, to assess psychosocial variables and emotional and behavioral functioning, and a daily diary booklet over 7 consecutive days, to assess occurrence of negative events, at baseline, 6, and 12 months. The questionnaires were mailed to the adolescents 2 weeks before each data collection wave. The participant was instructed to bring the completed questionnaire to an in-person meeting session. At the in-person meeting, adolescents were trained on the ecological momentary assessment procedures and how to record events in the daily diary booklets. They then completed the daily diary booklets in their homes and turned them in at another in-person meeting 1 week later. Students were paid \$10 upon receipt of the initial completed questionnaire and then an additional \$40 at the end of the week after completion of the 7-day ecological momentary assessment data recording.

Measures

Depressive symptoms. Adolescents’ depressive symptoms were measured with the Children’s Depression Inventory (CDI; Kovacs, 1985). The CDI is a widely used, standardized, 27-item child and adolescent self-report measure that assesses the severity of current depressive symptoms. Each item was rated on a scale from 1 to 3. We used item total scores that ranged from 1 to 3. Higher scores indicate greater symptom severity. α in this sample was .87.

Parent depressive symptoms were measured with the Center for Epidemiological Studies Depression Scale (CESD; Radloff, 1977). The CESD is a commonly used reliable and valid 20-item scale to assess the severity of adult depressive symptoms. Parents rated each of 20 items on a scale from 1 to 4 at the baseline assessment. Internal consistency was .85. We used the CESD to examine whether parental depressive symptoms needed to be controlled for in analyses of our main hypotheses. CESD data were available for 443 parents (86% mothers).

Alcohol problems scale. Alcohol use was measured with a 4-item scale asking participants: (1) when they last drank alcohol; (2) when they drink, on average, how much do they usually have; (3) what is the greatest amount of alcohol they have ever had at one time; and (4) how often they have gotten drunk during the past year. Responses for each item (ranging from 1 to 8) were averaged to form a scale score. Coefficient α across all measurement waves varied from .89 to .90.

Assessment of Stressors

Occurrence of stressors was measured through coding the adolescents' daily recordings of the "worst event" they experienced every day for 6–7 consecutive days in their daily diary booklet. In the diary booklet, the youth were asked to write down the "worst event" that occurred to them that day and then explain "what made it the worst event." Examples of events written by the adolescents include, "got kicked out of school," "dropped all my books in the hallway," "got an F on my quiz," "got in argument with my mother," "girlfriend got mad at me," "brother got arrested," and "my best friend's mother passed away," and "my football team lost the game." Coders were trained to rate reliably the threat and the domain of the stressors based on the youths' written description of the event and the context for why it was negative (i.e., based on what the youth wrote down in the diary in response to what was the worst event, why, whom the youth was with, and what the youth did). The investigator-based coding system that the raters used was modeled after the "contextual threat" method first used with adults (Brown & Harris, 1978) and then with youth (Adrian & Hammen, 1993). Raters first decided whether the event counted as a minimally threatening stressful negative event using established criteria based on the "contextual threat" coding system. Minimally threatening events were defined as those that would be considered stressful to most adolescents given the context of the event. For example, several events are stressful and threatening by definition to most adolescents

(e.g., "got kicked out of school" or "got an F on my quiz"), whereas other events (e.g., "dropped all my books in the hallway") may meet criteria for minimally threatening depending largely on the context (e.g., if the youth wrote that "classmates laughed at me" in the diary section stating "why it was the worst event," then that context would lead to coding the event as minimally threatening, but "nothing bad happened" would lead to coding the event as not minimally threatening.) Events were also categorized into domain-specific content areas. *Interpersonal* stressors, those events that involve a significant interaction between the youth and another person, were classified into family, peer, and romantic contextual domains. *Achievement* stressors included noninterpersonal events and were classified into academic/school or athletic/sports problems. Some events were categorized into multiple contextual domains (e.g., "lost the final softball game in gym class" was counted in both the school and athletic domains but only once for achievement), so the domain categories are not entirely mutually exclusive. Lastly, the raters determined the degree of dependency of each event, or the extent to which the adolescent contributed to the occurrence of the event based on the youth's behavior or characteristics (e.g., personality), on a scale of 1 (*completely independent*) to 5 (*completely dependent*). For instance, a 1 would apply to a completely independent event over which the child had no influence, such as the hospitalization of a family member; a 3 would describe a fight with a friend; and a 5 would be assigned to an adolescent failing an exam due to cheating. Events rated as 3 or above were categorized as dependent for analyses. In sum, the number of times that an adolescent experienced a minimally threatening event in a particular contextual domain across the 7 days within a particular wave was the actual value used in the present analyses.

All of the negative events that youth recorded in the diary booklets, across all three waves for the 7 consecutive days, were coded twice by independent coders. The statistic for agreement on coding stressors to be minimally threatening was .51. Coders were reliable (>85% agreement) in the ratings of threat, contextual domain, and dependency. The few discrepancies were resolved through consensual team meetings involving the first author and all raters.

Results

Preliminary Analyses

Compliance with adolescents completing the diaries was excellent. Overall, 96% of adolescents

Table 1
 Descriptive Statistics and Sex Differences in Depressive Symptoms, Alcohol Usage, and Stressors in Contextual Domains

Construct	Overall		Boys		Girls		Intercept B	SE	t	Slope B	SE	t
	M	SD	M	SD	M	SD						
CDI	1.37	0.29	1.34	0.27	1.40	0.29	.04	.01	3.26***	-.00	.00	0.96
Stressors	1.50	1.59	1.40	1.53	1.76	1.63	.22	.05	3.44***	-.11	.09	-1.19
Interpersonal stressors	0.78	1.11	0.50	0.85	1.02	1.25	.29	.03	6.34***	-.05	.06	-0.77
Achievement stressors	0.20	0.50	0.24	0.57	0.16	0.42	-.05	.01	-2.13	.01	.02	0.52
Dependent stressors	0.69	1.09	0.53	0.93	0.84	1.19	.16	.03	3.67***	-.02	.04	-0.57
Independent stressors	0.44	0.99	0.34	0.84	0.53	1.09	.12	.03	2.72**	.01	.01	0.81
Family stressors	0.40	0.75	0.27	0.61	0.57	0.93	.17	.02	5.63***	-.19	.25	-0.75
Peer stressors	0.37	0.69	0.26	0.58	0.54	0.89	.12	.02	4.12***	.01	.02	0.66
Romantic stressors	0.04	0.22	0.01	0.12	0.06	0.29	.03	.00	3.69***	.00	.00	1.18
School stressors	0.18	0.48	0.23	0.59	0.16	0.44	-.04	.01	-2.03	.02	.03	0.74
Athletic stressors	0.06	0.28	0.10	0.37	0.04	0.22	-.03	.01	-2.62**	.00	.01	0.13
Alcohol usage	3.75	0.12	3.78	0.13	3.72	0.11	-.03	.09	-0.030	.02	.02	0.95

Note. CDI = Children's Depression Inventory.

N = 538 for overall sample of adolescents with available data across the three waves of data for analyses.

** $p < .01$, *** $p < .001$ after the Bonferroni method to correct for multiple analyses. The intercept coefficient and SE refer to examination of sex differences of constructs at baseline, whereas the coefficient and SE for Slope refer to tests of sex differences in constructs over time.

wrote down events in their diaries that were available to be coded on any given day; of these adolescents, 89% of girls and 92% of boys completed a diary over a week (minimum of 5 days). No significant differences were found in compliance over time or by sex. Of the reported events, coders rated 83.4% as stressors that met the minimum threat criterion to count as a stressor (86.4% for girls; 80% for boys). This was not a significant sex difference, $\chi^2 = 1.72$, *ns*. The lack of a significant sex difference in either compliance or proportion of overall events rated as minimally threatening suggests that there is little evidence to suspect sex-linked biases in the contextual ratings of stressors overall, although we cannot disentangle subjective appraisal biases for exposure to events in particular domains.

Table 1 shows descriptive statistics for depressive symptoms and the number of coded stressors in different contextual domains experienced over a week averaged across the three waves of data. Table 2 shows associations among coded stressors from different domains at Wave 1 to provide a sense of the overlap among these different stressors. We used hierarchical linear modeling (HLM 5.04; Bryk & Raudenbush, 1992; Raudenbush, 2000; Raudenbush, Bryk, Cheong, & Congdon, 2001) for analyses. First, we examined whether there were any race differences in the depressive symptoms and stressors. Race (Caucasian vs. Non-Caucasian) was entered as a between the subjects variable at Level 2, with each of the particular outcome variables (i.e., depressive symptoms, stressors in the different

Table 2
 Association Among Stressors in Different Domains

	Interpersonal	Achievement	Family	Peer	Romantic	School	Athletic	Dependent
Interpersonal								
Achievement	.08							
Family	.74***	.07						
Peer	.61***	.21***	.12**					
Romantic	.17***	-.02	.13**	.16***				
School	.21***	.59***	.10*	.09*	.00			
Athletic	-.02	.53***	.00	.24***	.05	.05		
Dependent	.67***	.28***	.56***	.39***	.16***	.42***	.09*	
Independent	.49***	.41***	.39***	.59***	.32***	.28***	.39***	-

Note. N = 538 for overall sample of adolescents from Wave 1.

* $p < .05$, ** $p < .01$, *** $p < .001$.

domains) as the within-subjects variable at Level 1. There was no significant race effect for any variables, and hence we did not include race in the remaining analyses. We also used HLM to examine whether there were school effects for main outcomes; there were none, and hence schools were not included as a factor in the multilevel analyses.

Longitudinal Analyses by Sex and Cohort for Depressive Symptoms, Alcohol Use, and Stressors

We used HLM to address the main questions in this study. Modified Bonferroni corrections were used to adjust for conducting multiple analyses (Keppel, 1991). We examined whether there were significant time trends in depressive symptoms, alcohol usage, and stressors of different domains and whether sex and/or grade cohort (8th- and 10th-grade cohorts at baseline) moderated these longitudinal trajectory patterns using random-intercept and random-slope models. We entered the main effects of sex and cohort and their interaction at Level 2 to explain (1) mean levels (i.e., intercept) and (2) time trends (i.e., slopes) of the main outcome variables (i.e., depressive symptoms, alcohol usage, and stressors) at Level 1. There were no significant Sex \times Cohort interactions for any of the outcomes. Next, we entered the main effects of sex and parental depressive symptoms, and their interaction, to account for intercepts and slopes for the main outcomes in order to ascertain whether parental depressive symptoms needed to be controlled for in analyses examining main hypotheses. The sex difference in adolescent depression was not associated with parental depressive symptoms, although the main effect of parental depression was associated with depressive symptoms and alcohol usage, as expected (Downey & Coyne, 1990). The final results are reported from analyses in which all nonsignificant interactions were removed. Table 1 shows the sex difference results. Table 3 shows the results for the longitudinal patterns for the different outcomes.

For depressive symptoms and athletic stressors, there was no main effect of time or cohort or any significant interactions (i.e., Grade \times Cohort interaction, or Sex \times Time interaction). These analyses reveal that the levels of depressive symptoms and athletic stressors did not substantially change over time. For peer stressors, there were significant main effects of time and cohort, but no interactions with cohort or sex. These results show that peer-related stressors decreased over time, but the 10th graders encountered more overall peer stressors than did 8th graders on average. For overall, interpersonal, inde-

Table 3
Depressive Symptoms and Stressors in Different Domains Over Time by Grade Cohort

Variable	Estimate	SE	t
Depressive symptoms			
Cohort	.0	.01	-0.19
Time	-.01	.01	-0.98
Overall stressors			
Cohort	.08	.05	1.58
Time	-.32	.08	-3.84***
Interpersonal stressors			
Cohort	.04	.03	1.17
Time	-.26	.06	-4.39***
Achievement stressors			
Cohort	-.01	.02	-0.50
Time	-.19	.05	-3.21***
Time \times Cohort	.05	.03	1.95
Independent stressors			
Cohort	.02	.02	0.79
Time	-.32	.05	-6.16***
Dependent stressors			
Cohort	-.05	.04	-1.31
Time	-.36	.12	-3.05**
Time \times Cohort	.15	.05	2.69**
Family stressors			
Cohort	.00	.02	0.31
Time	-.12	.04	-2.83**
Peer stressors			
Cohort	.04	.02	2.37*
Time	-.13	.03	-3.36***
Romantic stressors			
Cohort	.01	.00	1.14
Time	-.01	.01	-1.03
School stressors			
Cohort	.01	.02	0.34
Time	-.20	.05	-3.50***
Time \times Cohort	.06	.02	2.24*
Athletic stressors			
Cohort	.00	.00	0.12
Time	-.02	.01	-1.59

Note. $N = 538$ for overall sample of adolescents with available data across the three waves of data for analyses. Cohort refers to 8th and 10th grades at baseline assessment. Nonsignificant Time \times Cohort interactions are not reported.

* $p < .05$, ** $p < .01$, *** $p < .001$ after the Bonferroni method to correct for multiple analyses.

pendent, and family stressors, there was a significant main effect of time only but no significant interactions with cohort or sex. These analyses show that these stressors significantly decreased over time equally across sex and grade cohort. For dependent and school stressors, there was a main effect of time, but this was qualified by a significant Cohort \times Time. Follow-up analyses examining the effect of time within each

grade showed that for dependent stressors, the 8th-grade cohort declined over time ($B = -.18$), but the 10th-grade cohort reported more dependent stressors over time ($B = .15$), and for school stressors 8th graders decline over time ($B = -.16$), but 10th graders did not significantly change ($B = .04$). Finally, there was a significant cohort effect for alcohol usage such that 10th graders reported using more alcohol than 8th graders; there were no interactions with time or sex.

Sex Differences in Depression and Stressors in Contextual Domains

Although there were no significant Sex \times Time effects, there were several significant main effect sex differences found in depressive symptoms and various stressors. Table 1 shows the means and standard deviations, separately for boys and girls, and the results test for sex differences in these outcomes. Consistent with past findings and our hypotheses, girls exhibited greater levels of depressive symptoms and more coded stressors overall, as well as in the interpersonal contextual domain, whereas results showed a trend for boys experiencing more coded stressors in the achievement domain. Analyses within specific contextual domains and by independent/dependent types of events showed that girls, compared with boys, reported more independent and dependent events, as well as more family, peer, and romantic stressors, whereas boys reported more athletic stressors than girls. There was no significant sex difference in alcohol usage at baseline or over time. Overall, these results show that there were significant sex differences in depressive symptoms and different stressors domains that were present at baseline and these trajectory patterns did not change substantially over the 1-year longitudinal follow-up (i.e., no Sex \times Time interactions).

Stress Exposure—Mediational Analyses

We examined the stress exposure—mediation hypothesis according to Baron and Kenny's (1986) logic (see also Holmbeck, 2002). To do so, the following conditions must be met: (1) girls must exhibit greater levels of depression than boys; (2) girls must experience more stressors over time than boys; (3) fluctuations in stressors over time must be associated with fluctuations in depressive symptoms over time controlling for sex; and (4) the significant association between sex and depression will be reduced once stressors are included in the analysis. Our above findings met Conditions 1 and 2 in that girls, com-

pared with boys, exhibited greater levels of depressive symptoms (Condition 1) and stressors (Condition 2) in many domains. Next we used HLM, in which variation in depressive symptoms over time was the outcome, stressors was a within-person Level 1 time-varying covariate, and sex was a Level 2 between-subjects factor, to test Conditions 3 and 4 simultaneously for the stress exposure—mediation hypothesis. Table 4 shows the results.

Overall stressors, interpersonal stressors, dependent stressors, independent stressors, family stressors, peer stressors, and romantic stressor, all accounted for part of the association between sex and individual fluctuations in depressive symptoms. Additionally, we used MacKinnon and colleagues' recommendations (MacKinnon & Dwyer, 1993; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002) to ascertain the strength of these mediators. Interpersonal stressors, dependent stressors, family stressors, and peer stressors explained more of this association. Overall, stressors in different contextual domains explained between 7% (romantic stressors) and 31% (overall interpersonal stressors) of the association between sex and depressive symptom trajectories over time. Figure 1 illustrates this model using overall interpersonal stressors.

These mediational analyses examined the hypothesis that cooccurring fluctuations in stressors over time will explain, at least in part, the sex difference in fluctuations in depressive symptoms over time. Although this analytic method of investigating concurrent fluctuations between depressive symptoms and stressors makes sense, given that there was no time or Time \times Sex interaction in depressive symptoms, we went further and conducted additional, more rigorous longitudinal analyses to examine the temporal direction of the effects. In other words, the stress exposure hypothesis implies that stressors at one time point will predict later depressive symptoms. To investigate more thoroughly whether stressors in particular domains at one assessment predict future prospective depressive symptoms, we fit separate HLMs that included a depressive symptoms intercept, a stressors' intercept, a depressive symptoms slope, a stressors' slope, and sex for the stressors that the prior mediational analyses showed were potential mediators (see Table 5). In these models, there are two paths of main interest to examine the direction of effects: (1) between the depressive symptoms intercept and the stressors' slope, and (2) between the stressors' intercept and the depressive symptoms slope. The first directional effect examines the stress generation hypothesis (Hammen, 1991) in which elevated

Table 4

Mediational Analyses Examining the Stress Exposure Hypothesis as an Explanation for the Sex Difference in Adolescent Depression

	Estimate	SE	<i>t</i>	Sobel test	% accounted
Step 1: Depressive symptoms outcome					
Sex	0.036	.01	3.26***		
Step 2: Depressive symptoms outcome					
(1) Sex	0.029	.01	2.71**	2.36*	12
Overall stressors	0.023	.01	3.27***		
(2) Sex	0.023	.01	2.13*	3.27***	31
Interpersonal stressors	0.040	.01	3.59***		
(3) Sex	0.024	.01	2.33*	3.17***	24
Overall dependent stressors	0.050	.01	4.43***		
(4) Sex	0.030	.01	2.78**	2.28*	9
Overall independent stressors	0.035	.01	3.27***		
(5) Sex	0.028	.01	2.70**	3.08***	22
Overall family stressors	0.049	.01	3.49***		
(6) Sex	0.027	.01	2.64**	3.17***	24
Overall peer stressors	0.057	.01	3.70***		
(7) Sex	0.032	.01	3.06**	2.29*	7
Overall romantic stressors	13	.04	2.72**		

Note. $N = 538$ for overall sample of adolescents with available data across the three waves of data for analyses.

* $p < .05$, ** $p < .01$, *** $p < .001$.

depressive symptoms are hypothesized to contribute to greater exposure of stressors over time, and the second directional effect examines the stress exposure hypothesis in which greater depressive symptoms are experienced over time after being exposed to more stressors earlier in time.

Findings from these HLM analyses, as can be seen in Table 5, revealed that the direction of longitudinal effects depended on which type and domain of stressor was examined. Evidence for stress generation was observed: The depression intercept significantly predicted the romantic stressors' slope and marginally the dependent stressors' slope ($p = .07$), but the stressor intercept in these domains did not predict the depressive symptoms slope. In contrast, stress exposure also was seen: The intercepts for independent and peer stressors significantly and in-

terpersonal stressors marginally ($p = .07$) predicted the depression slope, but the depression intercept did not predict the stressors' slope for any of these stressor domains. Finally, no support was found for stress generation or exposure for overall stressors and family stressors, and there was no evidence of bidirectionality between depressive symptoms and stressors in any contextual domains.

Stress Reactivity—Moderational Analyses

To examine the stress—reactivity moderation model, HLM was used. Fluctuations in depressive symptoms over time were the outcome variable, the different types of stressors were entered as a time-varying covariate at Level 1, and sex was entered as a cross-level interaction with stressors at Level 2. These analyses, which are shown in Table 6, test the hypothesis that the association between particular types of stressors and depressive symptoms is stronger for either girls or boys. As can be seen in Table 6, girls exhibited greater levels of depressive symptoms compared with boys as the levels of stressors increased for overall stressors, interpersonal stressors (marginally significant at $p = .06$), achievement stressors, dependent stressors (marginally significant at $p = .07$), independent stressors, and peer stressors. There was no significant interaction with sex for family, school, romantic, or

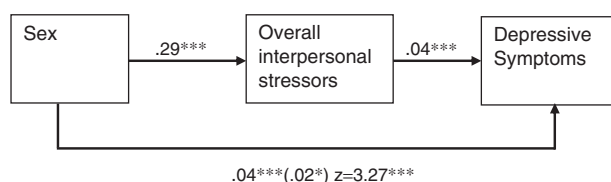


Figure 1. Stress exposure model with overall interpersonal stressors. The occurrence of more interpersonal stressors partially mediated the association (31%) between sex and depressive symptoms.

Table 5

Temporal Direction of Effects Between Stressors and Depressive Symptoms: Stress Generation and Stress Exposure Models in Adolescent Depression in Different Stress Domains

Stressor domain	Estimate	SE	t
Stress generation model (depressive symptoms intercept predicts stress slope controlling for initial stress)			
Overall stressors	.03	.08	0.36
Interpersonal stressors	.09	.05	1.62
Overall dependent stressors	.10	.06	1.78 ($p = .07$)
Overall independent stressors	-.01	.08	-0.17
Overall family stressors	.03	.04	0.86
Overall peer stressors	-.02	.03	-0.56
Overall romantic stressors	.04	.01	3.92***
Stress exposure model (stress intercept predicts depressive symptoms slope controlling for initial depression)			
Overall stressors	.01	.01	1.04
Interpersonal stressors	.02	.01	1.77 ($p = .07$)
Overall dependent stressors	.02	.01	0.84
Overall independent stressors	.03	.01	2.44*
Overall family stressors	.02	.02	0.90
Overall peer stressors	.05	.02	2.59**
Overall romantic stressors	.08	.06	1.32

Note. $N = 538$ for overall sample for adolescents with available data across the three waves of data for analyses.

* $p < .05$, ** $p < .01$, *** $p < .001$.

athletic stressors. Figure 2 illustrates this stress reactivity model using overall stressors as an example to depict the form of these significant Sex \times Stressor interactions. In all cases, girls who reported more stressors, in these different domains, reacted more strongly with depressive symptoms than did boys.

Table 6

Moderational Analyses Examining the Stress Reactivity Hypothesis as an Explanation for the Sex Difference in Adolescent Depression

Sex \times Stressor Interaction	Estimate	SE	t
(1) Sex \times Overall Stressors	.016	.01	3.37***
(2) Sex \times Interpersonal Stressors	.015	.01	1.87 ($p = .06$)
(3) Sex \times Achievement Stressors	.047	.02	2.32*
(4) Sex \times Dependent Stressors	.017	.01	1.89 ($p = .07$)
(5) Sex \times Independent Stressors	.029	.01	2.84**
(6) Sex \times Peer Stressors	.041	.01	3.32***
(7) Sex \times Family Stressors	.020	.01	1.66
(8) Sex \times Romantic Stressors	.079	.05	1.38
(9) Sex \times School Stressors	.032	.02	1.59
(10) Sex \times Athletic Stressors	.049	.03	1.55

Note. $N = 538$ for overall sample for adolescents with available data across the three waves of data for analyses.

* $p < .05$, ** $p < .01$, *** $p < .001$.

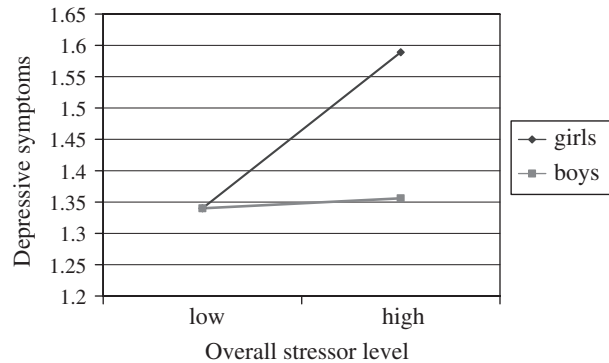


Figure 2. Stress reactivity model with overall stressors. Girls reacted more strongly to general stressors with greater elevations in depressive symptoms compared with boys. High and low levels of stressor level were defined according to ± 1 SD.

Finally, we used HLM to examine the emotional distress symptom specificity of the stress reactivity model. As with the analyses just reported, fluctuations in alcohol use over time were the outcome variable, the different types of stressors were entered as a time-varying covariate at Level 1, and sex was entered as a cross-level interaction with stressors at Level 2. None of the Sex \times Stressor interactions was significant in predicting trajectories of alcohol usage over time (all t values < 1.50). Also, as can be seen in Table 1, there was no significant sex difference in average levels of alcohol usage, and hence we could not test stress exposure as a mediational model. In sum, these analyses suggest that adolescent girls reacted specifically with greater depressive symptoms to stressors in particular domains but not to other forms of emotional distress (i.e., alcohol usage).

Discussion

The current multiwave, prospective research examined stress exposure and reactivity models as potential explanations for why more adolescent girls exhibit depressive symptoms than boys. The current study used a modified contextual stress methodology in which the occurrence of stressors was coded to minimize the reliance on adolescents' subjective report of stress and to categorize events into developmentally salient contextual domains (e.g., school, family, peers). In the sections that follow, we review and discuss the main findings that emerged in this study concerning two key issues: (1) the longitudinal patterns of depressive symptoms, alcohol usage, and contextual stressors by sex and grade cohort, and (2) stress exposure and reactivity models as

explanations for why more girls become depressed than boys in adolescence.

Longitudinal Patterns in Depressive Symptoms, Alcohol Use, and Stressors by Grade Cohort and Sex

The results showed that both 8th- and 10th-grade girls exhibited elevated levels of depressive symptoms compared with boys, and this sex difference was maintained over the 1-year follow-up in the study. Depressive symptoms did not change significantly over time and were not more prevalent in 10th versus 8th graders. These findings are consistent with a bevy of previous studies demonstrating the basic sex difference in adolescent depression that is apparent by age 12–13, and there are little to no age changes in depressive symptoms between 8th and 10th grades (e.g., Galambos, Leadbeater, & Barker, 2004; Hankin & Abela, 2005; Twenge & Nolen-Hoeksema, 2002). In addition, we studied alcohol usage to examine the emotional distress specificity in response to stressors. We found no evidence for a significant sex difference and no changes over time in alcohol usage. Older adolescents (10th graders) reported greater alcohol usage compared with 8th graders. These alcohol results are also consistent with past research (Kassel, Weinstein, Skitch, Veiloux, & Mermelstein, 2005).

The longitudinal patterns in stressors coded in developmentally salient contextual domains varied considerably depending on the type of contextual domain in which the stressor took place. It is essential to know what kind of stressor (e.g., independent vs. dependent) and in what domain the stressor occurred (e.g., peer vs. athletic) to gain a more complete understanding of the developmental trajectories in stressors, particularly for boys and girls of different grades. Specifically, girls experienced more overall, independent/fateful, dependent, and interpersonal stressors (specifically those in the domains of family, peers, and romantic relationships). Given that girls reported more “independent” events, as this term is used commonly in the stress field and literature (Hammen, 2005), compared with boys, it appears the term “independent,” used to describe stressors that are outside of one’s control or separate from one’s behaviors and characteristics, might be a misnomer and perhaps should be re-labeled as “fateful” events because our results suggest that these fateful events are dependent on an adolescent’s sex. Although our findings suggest that there are sex differences in adolescents’ exposure to stressors in different domains, it could still be argued that girls provided more detailed descriptions of

events than males, and hence girls’ greater exposure to stressors could be explained away by a sex difference in how events were reported. However, arguing against this hypothesis, boys and girls did not differ in the overall number of events reported in the diaries, which were available to be coded, or in the overall proportion of events judged to be minimally threatening. Thus, the sex difference in stressors could not be explained away by a bias in whether girls or boys provided sufficient detail in diaries to code events as minimally threatening.

There were also various grade cohort, time, and grade Cohort \times Time effects for some stressors. The only significant cohort effect was found for peer stressors: 10th graders encountered more peer stressors than 8th graders. These findings are consistent with developmental theory and evidence showing that the importance of the peer group as a socializing context increases during adolescence (Larson & Asmussen, 1991; Laursen, 1996; Steinberg & Silverberg, 1986). Time effects were observed for overall stressors and events in all domains, except romantic and athletic stressors. Stressors in almost all domains decreased over time. This may reflect the method of repeated assessments, as other researchers have demonstrated decreases in constructs over time with repeated measurement (e.g., Sharpe & Gilbert, 1998; Twenge & Nolen-Hoeksema, 2002); yet this cannot completely explain the decrease over time because significant declines were not observed across all domains, and as we discuss next, some of these time effects were moderated by grade cohort. Cohort \times Time interaction effects were found for dependent and stressors in the school domain. School stressors declined over time for 8th graders but did not change for 10th graders, whereas overall dependent stressors also decreased over time for 8th graders but increased for 10th graders. We are not aware of longitudinal research investigating time trends in different types of contextual domains of stressors, and hence these original findings await future replication and theoretical explanation.

Previous studies have either examined cross-sectional, age-related differences in self-reported stressors in various domains (e.g., Larson & Ham, 1993; Wagner & Compas, 1990), longitudinal changes in self-reported general stressors (e.g., Ge et al., 1994), or contextual threat interviews to code for objective stressors in cross-sectional research (e.g., Rudolph & Hammen, 1999). Overall, the findings between past research and the present study are remarkably comparable, especially given the differences in methodologies, designs, and samples.

Stress Exposure Model as an Explanation for the Sex Difference in Adolescent Depression

Given these sex differences in depression and stress, we tested and found evidence for the stress exposure model using mediation analyses that examined concurrent fluctuations between depressive symptoms and stressors in different domains. Stressors in all of the domains in which girls experienced more stressors than boys (i.e., overall, interpersonal, dependent, fateful, family, peer, and romantic) partially mediated and explained, to varying degrees, the concurrent sex–depression association over the three waves. Girls' greater exposure to interpersonal stressors, especially those in the family and peer domains, best accounted for why girls demonstrated more depressive symptoms than boys. This pattern of findings, in which girls' experience of more interpersonal stressors mediated more of the sex difference in adolescent depression, is consistent with past theory (e.g. Cyranowski et al., 2000; Hankin & Abramson, 2001; Rudolph, 2002) and research showing that girls' greater exposure to peer stressors (Liu & Kaplan, 1999; Rudolph & Hammen, 1999; Rudolph, 2002) partially accounts for girls' greater levels of depressive symptomatology compared with boys.

However, it is important to emphasize that these mediational findings emerged in analyses that examined concurrent fluctuations between depressive symptoms and stressors over the three time points; these analyses did not evaluate the longitudinal direction of the association between stressors and depressive symptoms. To address this issue, we conducted additional analyses that included a longitudinal path between initial depressive symptoms and later stressors (a stress generation model; e.g., Hammen, 1991) as well as a prospective path between initial stressors and later depressive symptoms (a stress exposure model) to test more rigorously the direction of the effects over time. The results showed that both stress generation and stress exposure models were supported and that the direction of longitudinal effects depended on which type and domain of stressor was examined. Consistent with the stress generation model, initial levels of depression contributed to greater amounts of romantic, and to a lesser extent to overall dependent, stressors. In contrast, baseline levels of fateful, peer, and to a lesser extent overall interpersonal, stressors predicted elevated levels of depressive symptoms over time, consistent with the stress exposure model. These findings are novel and important because they highlight the longitudinal nature of relationships

between depressive symptoms and stressors in different domains over time, and moreover, reveal that these longitudinal associations vary depending on the type and domain of stressor examined.

We consider two implications of these longitudinal results, in particular. First, these findings are consistent with Hammen and colleagues' work (e.g., Hammen, 1999), showing that elevated levels of depression contribute to dependent stressors, whereas depression does not predict independent, fateful events. In contrast, fateful stressors are hypothesized to contribute to greater depression over time, and we found evidence for this distinction between dependent and independent/fateful stressors and their proposed differential longitudinal associations with depression. Second, these results have interesting implications for the stress exposure model as an explanation for the sex difference in adolescent depression. Although fluctuations in overall, interpersonal, dependent, fateful, family, peer, and romantic events partially mediated the concurrent association between sex and fluctuations in depressive symptoms over the three waves, only fateful, peer, and overall interpersonal (marginally) stressors longitudinally predicted elevated depressive symptoms over time and can be considered to be a prospective explanation for why girls experience elevated depression, as postulated by the stress exposure model. That romantic and overall dependent (marginally) stressors partially mediated the sex difference in adolescent depression, but were not longitudinally predictive of future depressive symptoms, shows that romantic and dependent stressors are important for understanding why more girls exhibit depression than boys, and yet the transactional processes between these stressors and depressive symptoms over time differ from the longitudinal mechanisms linking fateful, peer, and overall stressors with depression over time. As these longitudinal, directional findings are novel, we await future investigations aimed at advancing knowledge on how different transactional, developmental processes underlie the stress exposure and generation mechanisms and influence why more adolescent girls are becoming depressed than boys.

Stress Reactivity Model as an Explanation for the Sex Difference in Adolescent Depression

In addition to the stress exposure model, we also examined a complementary model, the stress reactivity model, that states that girls react more strongly and experience greater depressive symptomatology than boys, given the same stressful events.

The results also supported the stress exposure model, for some, but not all, of the stressor domains. Specifically, girls reacted with more depressive symptoms than boys in the face of overall stressors, general achievement stressors, fateful stressors, and peer stressors. Moreover, girls' reactivity in response to these stressors was associated specifically with depressive symptoms, but not to all forms of emotional distress, because girls did not exhibit any more or less alcohol usage than boys in response to stressors.

The past research on the stress reactivity model has yielded equivocal findings. Some studies have shown that girls experience more depression than boys under stressful circumstances (e.g., Achenbach et al., 1995; Ge et al., 1994, 1996; Marcotte et al., 2002; Rudolph, 2002; Schraedley et al., 1999), whereas others have not found this (Burt et al., 1988; Cauce et al., 1992; Larson & Ham, 1993; Leadbeater et al., 1999; Wagner & Compas, 1990). Regarding stressors in particular contextual domains, the few past studies suggest that girls exhibit more depression to interpersonal stressors than boys (Goodyer & Altham, 1991; Moran & Eckenrode, 1991), whereas boys display more depression to school stressors than girls (Sund et al., 2003). However, we did not find any evidence that boys exhibited more depressive symptoms than girls to school or general achievement events. In fact, we found the opposite: Girls displayed more depressive symptoms to overall achievement events compared with boys, although there was no significant interaction for specific school stressors.

Girls only exhibited more depressive symptoms than boys in response to peer stressors, not family or romantic stressors. This finding appears to conflict with past research showing that girls are more sensitive to interpersonal relationships, including family relations (e.g., Davies & Windle, 1997, 2001; Gore et al., 1993), than are boys, and moreover, girls appear to exhibit greater emotional distress than boys, given disruptive relationships (e.g., family discord; Davies & Windle, 1997; Gore et al., 1993). The precise reasons for the inconsistency in findings across studies are unclear. Our stress assessment method focused on episodic, largely minor hassles in different domains within a relatively short time frame (1 week) as opposed to chronic stressors or major negative life events over a longer time span (e.g., 1 year; Rudolph & Hammen, 1999). Girls may react with greater depressive symptoms than boys in response to episodic peer stressors (e.g., this study) and to chronic family discord (e.g., Davies & Windle, 1997). Future research is needed that uses contextual stress methods

to assess episodic and chronic events of minor and major threat in differing contextual domains, using a longitudinal design, to examine this issue.

Strengths and Limitations of the Present Research

The present investigation extended past research on sex differences in adolescent depression and stress by using a three-wave longitudinal design, a moderately large sample of community adolescents, daily diary assessment of naturalistically occurring stressors, coding of daily stressors into developmentally salient domains using contextual threat methods, and statistical techniques best suited for hierarchical, longitudinal data. These features enabled a more powerful examination of the stress exposure and reactivity models as explanations for the sex difference in adolescent depression, which emerges and expands during early to middle adolescence—the age range of this sample.

Nonetheless, potential limitations should be noted. First, the sample was selected based on smoking intentions and/or limited smoking experience. This sampling strategy may reduce the generalizability of the findings because youth who were susceptible to smoking were most targeted for inclusion into the study. However, this concern is mitigated because the participants fell into all categories of smokers (e.g., from those who never smoked to regular smokers), and the representation of mostly susceptible nonsmokers in this study is generally similar to that found in general community samples. Also, there was no sex difference by smoking experience. As such, the sample is unlikely to be biased seriously, especially for the primary focus in this study on sex differences in depression and stressors.

Second, the daily diary methodology and coding of events occurring within 1-week intervals, while being a strength in certain respects, is also limited in that it is most likely that daily hassles, as opposed to more major life events, were examined. Our daily diary method did pick up major life events, such as sexual assaults and death of loved ones, although these severe events were clearly infrequent. As such, the fact that mostly daily hassles were examined should be kept in mind when considering the results and conclusions. Third, adolescents reported the worst event that occurred on a daily basis, so additional stressors in other domains, apart from the worst event recorded, may not have been reported in the diary and thus were unavailable to be coded and examined in analyses. Also, our method of having adolescents report the worst event of the day confounds their appraisal of events with exposure to

events. There may exist subtle sex-linked appraisal biases in terms of which events youth report as the worst, although analyses showed a lack of a sex difference in proportion of overall events reported on any given day or events judged to be minimally threatening, and hence this mitigates this concern to some degree. Finally, our coding method cannot rule out whether the finding of a sex difference in stressors is due to different stress exposure levels, as hypothesized, or different response styles (e.g., Nolen-Hoeksema & Girgus, 1994). It is important that future research attempt to ascertain whether boys and girls respond to similar events in different ways in order to disentangle these possibilities.

Fourth, this study focused on stress models as potential explanations for the sex difference in adolescent depression. There are other conceptual models with empirical support that also account for the elevated levels of depressive symptoms in girls compared with boys. For example, negative perceptions of attractiveness and body image (e.g., Allgood-Merten et al., 1990; Cole et al., 1998; Seiffge-Krenke & Stemmler, 2002; Wichstrom, 1999), self-competence (O'hannessian, Lerner, & Lerner, 1999), negative cognitions (e.g., Hankin & Abramson, 2001; Mezulis, Abramson, Hyde, & Hankin, 2004), negative emotionality temperament (Goodyer, et al., 1993), latent genetic risk (Jacobson & Rowe, 1999; Silberg et al., 1999), and others have also been found to contribute to the preponderance of female depression in adolescence. These and other theoretical constructs were not assessed in the present study, and hence we were unable to examine them in an integrative fashion in concert with stressors in differing domains. Integrating stress exposure and reactivity with these other vulnerabilities is an important area for future research.

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