Differential Exposure and Reactivity to Interpersonal Stress Predict Sex Differences in Adolescent Depression

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This study tested the hypothesis that higher rates of depression in adolescent girls are explained by their greater exposure and reactivity to stress in the interpersonal domain in a large sample of 15-year-olds. Findings indicate that adolescent girls experienced higher levels of total and interpersonal episodic stress, whereas boys experienced higher levels of chronic stress (academic and close friendship domains). Higher rates of depression in girls were explained by their greater exposure to total stress, particularly interpersonal episodic stress. Adolescent girls were also more reactive (more likely to become depressed) to both total and interpersonal episodic stress. The findings suggest that girls experience higher levels of episodic stress and are more reactive to these stressors, increasing their likelihood of becoming depressed compared to boys. Results were discussed in terms of girls' greater interpersonal focus and implications for understanding sex differences in depression.

The female preponderance of depression and its emergence in adolescence are among the most robust findings in the field of psychology (e.g., Ge, Conger, & Elder, 2001; Kessler, McGonagle, Swartz, Blazer, & Nelson, 1993; Wade, Cairney, & Pevalin, 2002). What is less well understood is why adolescent girls—continuing into adulthood—are more depressed than boys. This article examines sex differences in stress processes for both episodic and chronic stressors as explanations of the sex differences observed in depression. Stressful events and ongoing circumstances are potent predictors of depressive episodes (e.g., Brown & Harris, 1989). As such, several investigators have hypothesized that girls' and women's greater exposure and reactivity to stressors contribute to the emergence of sex differences, especially when the stressors occur in interpersonal relationships (Cyranowski, Frank, Young, & Shear, 2000; Hankin & Abramson, 2001; Nolen-Hoeksema & Girgus, 1994; Rudolph, 2002).

A focus on interpersonal factors has recently emerged in the adult depression field, with researchers providing evidence that interpersonal vulnerability factors may be important contributors to risk for depression (see Hammen, 2000; Hammen & Rudolph, 2003; Joiner, 2002, for reviews). Along these lines, researchers have proposed that the emergence of the sex difference in depression in adolescence is closely related to the increased importance girls place on interpersonal relationships at this time (e.g., Cyranowski et al., 2000; Rudolph, 2002). Developmental trends that increase the salience of interpersonal connectedness in adolescence, especially for girls, may set the stage for two processes relevant to depression (a) increased exposure to interpersonal stressful life events and chronic stress (stress exposure) and (b) greater likelihood of girls' depressive reactions to such stressors (stress reactivity).

Preliminary evidence supports these two processes as important factors in understanding the sex difference. Two studies have shown higher rates of reported negative life events in girls compared to boys (All-good-Merten, Lewinsohn, & Hops, 1990; Ge, Lorenz, Conger, Elder, & Simons, 1994). Moreover, a few studies have specifically found that adolescent girls tend to experience more interpersonal stress whereas boys reported more school-related or noninterpersonal stress (Larson & Ham, 1993; Rudolph & Hammen, 1999). Similarly, Gore, Aseltine, and Colten (1993) found that girls reported more stressors related to their

social networks, whereas boys reported more stressors that directly affected themselves, rather than family and friends. Thus, studies may benefit from distinguishing between interpersonal and noninterpersonal domains when examining sex differences in stress exposure.

Although there is some evidence that girls experience more interpersonal stress, it is not clear what kinds of processes contribute to higher levels of interpersonal stress among girls. One possibility is that girls may be more likely to contribute to the occurrence of stressors in their own lives, particularly in their relationships. Hammen (1991) provided evidence for a stress generation process whereby depressed women experienced more dependent stressors. This subtype of stressful life events includes events to which the individual contributed. Hammen also noted that a large subset of dependent stressors depressed women experienced involved interpersonal conflict. Further, these stressors, in turn, maintained women's depression (see also Davila, Hammen, Burge, Paley, & Daley, 1995; Harkness, Monroe, Simons, & Thase, 1999). Similarly, in a clinic-referred sample, Rudolph and colleagues (Rudolph & Hammen, 1999; Rudolph et al., 2000) found that adolescent girls generated more interpersonal stress than adolescent boys, but this difference did not occur among preadolescent boys and girls. Rudolph (2002) speculated that adolescent girls normatively become intensely invested in the quality of their relationships and that their valuing of such interpersonal connections may sometimes lead to conflict and loss.

This study proposes to examine sex differences in exposure to stressful life events, distinguishing between potential differences in interpersonal and noninterpersonal domains. Further, extending previous work, we explore whether adolescent girls report more dependent interpersonal stress that is caused in part by their attitudes and behaviors, as compared to boys. However, simply demonstrating greater stress exposure for girls would be insufficient in furthering our understanding of the sex difference in depression. We also include a test of mediation to determine whether greater stress exposure in adolescent girls explains the relation between sex and depression (Nolen-Hoeksema & Girgus, 1994). That is, does being female predict greater stress exposure, which in turn predicts depression?

In addition to greater stress exposure, a second stress process—stress reactivity—may also explain the higher levels of depressive symptoms and diagnoses in girls. The relation between stress and depression may be different for boys and girls. That is, even at comparable levels of episodic stress, girls may still be more likely than boys to experience depression in response to stressors. Furthermore, it has been suggested that girls may exhibit greater reactivity to the specific category of interpersonal stress because they are more likely to prioritize others' needs over their own well-being (Cyranowski et al., 2000). Taking a developmental approach, Rudolph (2002) suggested that the shifts in interpersonal roles and disruptions in social networks that often accompany the transition to adolescence are particularly threatening to girls because they value their relationships more than boys. Studies have found empirical support for the reactivity hypothesis in that depressed mood is correlated more strongly with exposure to stressful life events in adolescent girls as compared to boys (Ge et al., 1994; Marcotte, Fortin, Potvin, & Papillon, 2002; Rudolph & Hammen, 1999; Schraedley, Gotlib, & Hayward, 1999).

Moreover, there is some evidence that adolescent girls are more reactive to interpersonal stress in particular (see Leadbeater, Blatt, & Quinlan, 1995, for a review). They are more likely than boys to become depressed in reaction to stressful life events involving others and in response to family members' difficulties (Gore et al., 1993; Leadbeater et al., 1995). In contrast, there is some evidence that adolescent boys' depressive symptoms are more strongly correlated with noninterpersonal stressors. Specifically, boys are more reactive to school-related stress, suggesting that this may be a domain boys value more (Sund, Larsson, & Wichstrom, 2003). Additional research is needed to better understand boys' and girls' depressive responses to different kinds of stressors.

The research reported so far has focused on exposure and reactivity to episodic stressors. Episodic stressors refer to stressful events or situations that are discrete in nature, with a beginning and ending. A complete picture of the role of stress in sex differences in depression, however, must also consider chronic stress. In contrast to episodic stressors, chronic stress is defined as ongoing difficulties and stressful circumstances (Hammen et al., 1987). Brown and Harris (1978) were among the first to show that chronic difficulties, in addition to episodic stressors, contributed significantly to depressive onsets. However, few studies have examined chronic stress in adolescence.

With respect to chronic stress exposure, a study of adults found that women experience more chronic stress than men (Nolen-Hoeksema, Larson, & Grayson, 1999), but it is unclear whether these results extend to adolescents. Similarly, there is evidence that adolescent girls experience more hassles than boys (Hastings, Anderson, & Kelley, 1996; Lai, Hamid, & Chow, 1996). Similar to episodic stress, researchers have also distinguished between interpersonal and noninterpersonal types of hassles. There is evidence that girls experience more peer-related hassles, whereas boys experience more school-related hassles (Heubeck & O'Sullivan, 1998). These findings seem to suggest that girls may experience more interpersonal chronic stress, whereas boys experience more nonin-

terpersonal chronic stress. Nonetheless, the findings on hassles may not extend to chronic stress, which is a related but theoretically distinct construct. The literature on depressive reactions to chronic stress (stress reactivity) is similarly limited. Among early adolescents, daily hassles were more strongly correlated with depressive symptoms in girls, as compared to boys (Sund et al., 2003), but this study did not distinguish between interpersonal and noninterpersonal hassles, and there have been no relevant studies on reactivity to chronic stress. More research is needed to systematically examine sex differences in exposure and reactivity to interpersonal and noninterpersonal chronic stress.

Theoretically, this study extends past stress and depression research on adolescent samples in several ways. First, it examines both chronic and episodic stress, enabling comparison of these two major categories of stressors. Given the lack of research on chronic stress among adolescents, its focus on chronic stress represents a novel contribution. Second, it compares interpersonal and noninterpersonal stress, a growing area of research. With respect to episodic stress, it focuses on dependent interpersonal stress, indicative of stress generation processes. There is growing consensus that models of the sex difference in depression need to take into account reciprocal transactions between adolescents and their environment (e.g., Nolen-Hoeksema, 2001; Rudolph, 2002), although few studies have explicitly tested for sex differences in relation to self-generated stress. Third, in addition to testing differential exposure and reactivity to stress, this study examines stress exposure as a mediator. Researchers have called for more sex difference studies to employ mediational analyses, which provide evidence that the relation between sex and depression can be accounted for by the mediating etiological variable (Hankin & Abramson, 1999; Nolen-Hoeksema & Girgus, 1994).

This study also addresses some methodological shortcomings of past research in this area. First, the study utilized a large sample of 816 adolescents, with an equal distribution of boys and girls, providing sufficient power to test for sex differences. Second, previous studies have generally utilized life-events checklists, which are prone to be affected by individuals' biases and mood, reducing their validity (see Duggal et al., 2000, for a review). In contrast, this study utilizes a semistructured-interview approach to stress assessment, which contextualizes stressors in the lives of individuals and provides objective ratings of stress severity. Few studies have employed these more innovative methods for stress assessment for adolescents. Third, previous studies have largely measured self-reported symptoms of depression rather than depression diagnoses, which may be subject to self-presentation biases and may not generalize to clinically ascertained depressive episodes. This study overcomes this limitation by examining both subclinical and clinical diagnoses

of major depression and dysthymia derived from systematic interviews of youth and their mothers.

We hypothesized that girls' higher level of depression is due to their greater exposure and reactivity to stress compared to boys, particularly in the interpersonal domain. To test these hypotheses, three sets of analyses were conducted. First, we examined sex differences in stress exposure, seeking to demonstrate that adolescent girls experienced higher levels of both episodic and chronic stress than boys, especially in the interpersonal domain. To test whether girls were more likely to engage in stress-generation processes and contribute to a more stressful social environment, we examined whether they experienced higher levels of a subtype of interpersonal stress that is, in part, dependent on their own behaviors. Stress exposure in the noninterpersonal domain was also examined to determine whether boys experienced higher levels of noninterpersonal episodic and chronic stress compared to girls. Second, we tested a mediation model hypothesizing that sex differences in rates of depression were accounted for by greater stress exposure in adolescent girls compared to boys. Third, we examined sex differences in stress reactivity. We hypothesized that sex would moderate the relation between stress and depression such that adolescent girls who experienced higher levels of stress would be more likely than boys to become depressed, especially in reaction to interpersonal stress.

Method

Participants

The participants were 816 youths (414 boys and 402 girls), mean age 15 years, 2 months (*SD* = .29), selected from a large birth cohort study of children born between 1981 and 1984 at the Mater Misericordiae Mother's Hospital in Brisbane, Queensland (Keeping et al., 1989; *n* = 7,775). A questionnaire follow-up by the prior investigators when the children were 13 years old identified 68% of the original birth cohort still in the Brisbane area, and participants in this study were drawn from this group.

The main project from which this study was derived examined the effects of maternal depression on children and therefore selected families who represented diverse experiences in severity and chronicity of depressive symptoms, including no depression. Sample selection at youth age 15 was based on mothers' scores on depression checklists that were administered by the previous investigators during pregnancy, after delivery, and when the child was 6 months and 5 years old (see Hammen & Brennan, 2001, for sample selection details). Actual diagnostic information was collected when the child was 15 years old. The mother sample

included 458 never-depressed women and 358 women with at least one current or past major depressive episode or dysthymic disorder. Children who participated in this study did not differ from the original birth cohort in terms of family income, maternal education, or sex.

The overall sample was 92% Caucasian, 8% minority (Asian, Pacific Islander, and Aboriginal). Median family income at the 15-year follow-up was AU$35,000–AU$45,000, indicating middle and lower middle class. Median mothers' education was Grade 10 (equivalent to U.S. high school graduation). The majority of the mothers (76.8%) were married or cohabitating.

Procedures

Mothers and children were interviewed in the family home. Interviewers had prior clinical and research experience and were trained and supervised by the authors (Hammen and Brennan). Interviewers were blind to the mother's depression status and history, and a team of two interviewers conducted the parent and child interviews separately and privately. The parents and children gave written informed consent (assent) and were paid for their participation, which lasted approximately 3.5 hr.

Measures

Youth diagnostic evaluation. Presence of current depressive disorders in the child was ascertained using the Schedule for Affective Disorders and Schizophrenia for School-Age Children—Revised for the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; American Psychiatric Association, 1994; Orvaschel, Lewinsohn, & Seeley, 1995), administered separately to the mother and the child. Diagnostic decisions were reviewed by the clinical rating team based on all available information. Orvaschel et al. reported excellent kappa reliability coefficients for major depression and dysthymia in youngsters. In this sample, weighted kappas were .82 for current clinical and subclinical major depressive episode and dysthymia diagnoses.

In this study, individuals were considered depressed if they currently met diagnostic criteria for either major depression ($n = 16$; 5 boys, 11 girls), dysthymia ($n = 13$; 3 boys, 10 girls), both major depression and dysthymia ($n = 2$; 0 boys, 2 girls), subclinical major depression ($n = 17$; 7 boys, 10 girls), or subclinical dysthymia ($n = 26$; 12 boys, 14 girls). Individuals who were considered subclinical met most but not all diagnostic criteria. Specifically, there were three ways in which individuals could be diagnosed as having subclinical major depressive episode or dysthymia: (a) if they had a sufficient number of symptoms to be diagnosed with the disorder but did not have sufficient duration of symptoms to meet full diagnostic criteria, (b) if they had sufficient duration of symptoms but fewer than the required number of symptoms (i.e., they met diagnostic criteria for minor depressive disorder), or (c) if they met symptom criteria and minimum duration but lacked sufficient impairment to meet full diagnostic criteria. In total, 74 adolescents (27 boys, 47 girls) were currently depressed, and 742 adolescents (386 boys, 356 girls) had no current depression. Studies have shown that individuals with subclinical forms of depression experience significant impairment and present with clinical features similar to those individuals with clinical depression (e.g., Kessler, Zhao, Blazer, & Swartz, 1997; Wells, Burnam, Rogers, Hays, & Camp, 1992). Given the continuity between subclinical and clinical forms of depression, this study categorized both subclinical and clinical depression and dysthymia diagnoses as "currently depressed" in the study analyses.[1]

Chronic stress. A semistructured interview was used to measure ongoing stressful circumstances over the past 6 months. The adolescent version of the chronic stress interview used in this study was developed from earlier versions of the interview for children (e.g., Adrian & Hammen, 1993) and adults (e.g., Hammen et al., 1987). The adolescent version queried ongoing conditions in six domains: social circle, close friendship, romantic relationships (or dating interest), relations with family members, academic performance, and school behavior. In the test of study hypotheses, academic performance and school behavior were considered noninterpersonal (academic) in content, and social circle, close friendship, romantic relationship, and family relationship were considered interpersonal. As such, interpersonal and noninterpersonal chronic stressors were operationalized as discrete, nonoverlapping constructs. Three composite scores of total chronic stress, interpersonal chronic stress, and noninterpersonal chronic stress were formed by summing the relevant chronic stress domain scores.

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[1]Additional analyses were conducted to address the question of continuity of depression and the validity of combining subclinical and clinical depression in this sample. Separate sets of logistic regressions were conducted with clinical depression and subclinical depression as the dependent variables. Examination of the odds ratios indicated findings in similar directions for both dependent variables. However, results for clinical depression were generally stronger than results for subclinical depression, both in terms of higher odds ratios and larger Wald test statistics. For example, the odds ratios for the prediction of depression by total episodic stress were 1.43 ($W = 6.49$, $p < .05$) for subclinical depression and 2.21 ($W = 22.86$, $p < .01$) for clinical depression. The results derived from these two sets of depression variables closely mirror those of the dependent variable used in the study, which combines subclinical and clinical depression into one category. The pattern of findings supported continuity of subclinical and clinical forms of depression.

To thoroughly assess chronic stress in each domain, interviewers probed each area with the youth, using standard general probes and follow-up queries where needed. The semistructured format allowed interviewers to obtain sufficient information to rate the individual on each domain using a 5-point scale with behaviorally specific anchors from 1 (*superior functioning*), 3 (*average functioning*), to 5 (*severe difficulties*).

For example, for close friendship, participants were asked about the quality of their relationship with their closest friend, including the extent to which there is closeness, trust, reciprocality, conflict, and stability in the friendship. A rating of 1 indicated a close friendship posing little chronic stress in that the relationship is close, confiding, mutually satisfying, and stable, with good conflict resolution; 3 indicated a close friendship that is unstable or sometimes has poor conflict resolution or a moderately close friendship that is fairly stable and nonconflictual; and 5 indicated absence of a close, confiding friendship or a highly conflictual relationship. Similar probes and rating criteria were used to objectively evaluate participants' functioning in the other chronic stress domains.

For social circle, ratings were based on social group size, how well participants related to peers, and frequency of social activities. For romantic relationship, participants with steady partners were rated on relationship quality, including stability, supportiveness, and conflict. Participants without romantic partners were rated on their satisfaction with being single, availability of potential partners, and dating experiences. For family relationship, participants were rated on the quality of their relationships with their parents, including closeness, communication, trust, acceptance, and conflict. For academic performance, ratings were based on participants' schoolwork, including grades, academic standing, and special assistance. For school behavior, participants were rated on their nonacademic school performance, including relationship with teachers and administrators and disciplinary action.

Reliabilities for chronic stress ratings were based on independent judges' ratings of audiotaped interviews (n = 88–96). Intraclass correlations across domains ranged from .60 (romantic relationship) to .94 (academic performance), with a mean of .77.

Episodic stress. Probes for episodic stressful life events were embedded in the chronic stress interview (e.g., Hammen, 1991; Hammen, Marks, Mayol, & deMayo, 1985), modeled after the contextual threat assessment of stressful life events (Brown & Harris, 1978). In contrast to chronic stress, episodic stress included discrete life events with a discernable beginning and ending. These discrete events occurred in the context of chronic stress, but they were not ongoing stressors. All of the events that received a stress rating were considered stressful even though some of these may be positive events. For example, starting a new dating relationship may be construed as a positive event but is also typically associated with some negative stress impact. In each content domain, interviewers identified spontaneous youth reports of specific occurrences and also specifically asked about episodic stressors in each content area over the past year. Additional stressor probes concerned finances, health of participants and their families, and any other relevant areas.

The semistructured interview probed each potential stressor and obtained information about the nature and consequences of the event and the circumstances in which it occurred. The interviewer presented a narrative of each event to a rating team that was blind to the youth's actual reactions to the stressor. The team rated each stressor on a 5-point scale of severity (how much negative impact the stressor would have on a typical person under similar conditions), ranging from 1, indicating no negative impact, to 5, indicating extremely severe negative impact. Data on reliability and predictive validity have been reported previously (e.g., Hammen, 1991). In this study, interrater reliabilities based on independent ratings by Australian and U.S. teams for 89 cases yielded intraclass correlations of .92 for severity rating.

Additionally, the teams rated each stressor for "independence," the degree to which an event was fateful, or unrelated to actions of the individual. Stressors were coded on a 5-point scale whereby 1 indicates that the event was entirely out of control of the individual, 3 indicates that the event was at least partially due to actions of the individual, and 5 indicates that the event was entirely due to the individual's actions. Interrater reliability based on a 5-point scale of independence was .89. For the purpose of this study, stressors rated as 3 or higher were coded as dependent and 2 or below as independent.[2]

The teams also determined whether each stressor's content was primarily interpersonal or noninterpersonal. Stressors were coded as interpersonal if they predominately involved relationships with other people (e.g., argument, break-up of relationship) or if they happened to others but affected the participant's relationship with that person (e.g., significant figure moves away or becomes ill). Stressors were coded as noninterpersonal if they did not meet either of these criteria. Every episodic stressor was coded as either falling into the interpersonal or noninterpersonal subcategory, with no overlap between subcategories.

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[2]Independence was not rated for chronic stress because the chronic stress ratings encompass ongoing conditions that are bound to include reciprocal relations between the person and the environment. If a single independence score was assigned to capture these ongoing circumstances, it would necessarily be "mixed" (partly dependent). As such, independence is not a particularly meaningful construct for chronic stress.

Episodic stress composite scores were computed by summing severity ratings for events within a given category of stress. Total episodic stress included ratings from all stressors whereas the interpersonal and total noninterpersonal stress totals were summed from mutually exclusive stress categories. In addition, stress severity ratings were summed for a specific class of stressors: those that were deemed both dependent and interpersonal in nature. The total for dependent interpersonal stress was computed to test hypotheses related to stress generation.

Results

Given the large sample size, effect sizes (ES) are reported for mean differences between girls and boys. Because the families were selected on the basis of mothers' depression history, maternal depression status was entered in all regression analyses to control for its potential impact on youths' stress and depression.

Overview of Total Episodic and Chronic Stress

Youths reported an average of 3.21 ($SD = 2.07$) episodic stressful life events over the year (range = 0 to 10). Seven percent reported no episodic events, and about 60% reported three or more events. Severe episodic events (those rated 3 or above) occurred among 9% of the sample. Girls ($M = 3.58$, $SD = 2.20$) experienced a significantly higher total number of episodic stressful life events than boys ($M = 2.85$, $SD = 1.87$), $t = 5.13$, $p < .001$, ES = .18. Girls ($M = 6.79$, $SD = 4.26$) also experienced higher total stress impact ratings compared to boys ($M = 5.22$, $SD = 3.54$), $t = 5.72$, $p < .001$, ES = .20 (see Table 1).

Total chronic stress ratings summed across the six domains ranged from 8 to 23.50 ($M = 13.85$, $SD = 2.23$). In contrast to the results for total episodic stress, boys ($M = 14.15$, $SD = 2.36$) experienced a higher level of chronic stress compared to girls ($M = 13.54$, $SD = 2.04$), $t = 3.92$, $p < .001$, ES = .14.

Sex Differences in Stress Exposure

Exposure to interpersonal stress. Table 1 presents the means, standard deviations, and test statistics for all sex comparisons. As expected, girls had higher levels of both interpersonal episodic stress and dependent interpersonal episodic stress with ES of .24 and .17, respectively. There were no sex differences in chronic stress levels using the interpersonal chronic stress composite scores. Analyses of individual chronic stress domains revealed findings in differing directions depending on the domain. Adolescent girls reported higher levels of chronic romantic stress compared to boys (ES = .13), and adolescent boys reported higher levels of chronic close friendship stress compared to girls (ES = .10). Boys and girls did not differ in their levels of chronic family and social circle stress.

Exposure to noninterpersonal stress. No sex differences in the level of noninterpersonal episodic stress were detected (see Table 1). Boys, however, experienced significantly higher levels of academic chronic stress with ES of .21, .20, and .16 for the composite

Table 1. *Sex Differences in Stress Exposure to Interpersonal and Noninterpersonal Stress*

	Girls		Boys			
	M	*SD*	*M*	*SD*	*t*	Effect Size
Total						
Total Number of Episodic Events	3.58	2.20	2.85	1.87	5.13**	.18
Total Episodic Stress	6.79	4.26	5.22	3.54	5.72**	.20
Total Chronic Stress	13.54	2.04	14.15	2.36	3.92**	.14
Interpersonal						
Episodic Interpersonal Stress	3.36	3.06	2.04	2.17	7.17**	.25
Episodic Dependent Interpersonal Stress	2.21	2.29	1.52	1.76	4.84**	.17
Chronic Stress						
Interpersonal Composite	8.99	1.26	8.98	1.26	<1.00	NA
Close Friendship	2.16	0.46	2.26	0.53	3.06*	.11
Social Circle	2.27	0.46	2.29	0.49	<1.00	NA
Romantic Life	2.20	0.43	2.10	0.31	3.73**	.13
Family	2.37	0.60	2.32	0.57	1.10	NA
Noninterpersonal						
Episodic Noninterpersonal Stress	3.40	2.90	3.21	2.80	<1.00	NA
Chronic Stress						
Academic Composite	4.55	1.37	5.17	1.62	5.88**	.21
Academic Performance	2.49	0.84	2.86	0.99	5.67**	.20
School Behavior	2.06	0.70	2.31	0.83	4.68**	.16

$*p < .05$. $** p < .01$.

measure and the specific domains of academic performance and school behavior.

Stress Exposure as an Explanation for Sex Differences in Depression

Hierarchical logistic regression analyses were conducted to determine whether higher rates of depression in girls can be explained by their greater stress exposure. Four mediators (total episodic stress, interpersonal episodic stress, dependent interpersonal episodic stress, and chronic romantic stress) were tested using guidelines set forth by Baron and Kenny (1986). In addition, maternal depression status was entered in the first step for all analyses to control for any impact maternal depression status may have on stress and depression levels.

For each mediator, four regression analyses were conducted to test the following: Does sex predict depression? Does sex predict higher levels of this particular type of stress? Do higher levels of this particular type of stress predict depression? Lastly, controlling for the higher stress levels, does sex still predict depression? How much of the sex–depression relation is explained by higher levels of stress exposure for girls?

Being female predicted higher levels of depression and higher levels of stress for all four stress variables tested (see Table 2). Furthermore, all four stress variables significantly predicted higher levels of depression. After controlling for the effects of greater stress exposure, sex either marginally or significantly predicted higher depression rates, indicating partial mediation rather than full mediation. MacKinnon and Dwyer's (1993) method for estimating mediated effects with logistic regression was used to assess stress variables' mediated effects. Differences in total episodic stress appear to explain 36% of the sex effect on depression rates, $\alpha\beta = .35$ (95% CI = .14–.57). Episodic interpersonal stress, a subset of total episodic stress, explains 29.7% of sex's effect on depression rates, $\alpha\beta = .27$ (95% CI = .10–.43). Differences in dependent episodic interpersonal stress, a subset of both episodic interpersonal stress and total episodic stress, explained 14.6% of the girls' higher rate of depression, $\alpha\beta = .11$ (95% CI = .02–.19). Lastly, differences in romantic chronic stress ratings were marginally significant in explaining only 2% of girls' higher rate of depression, $\alpha\beta = .01$ (95% CI = .001– .03). These findings suggest that higher levels of episodic stress (total, interpersonal, and dependent interpersonal) experienced by adolescent girls partially explain why girls have higher rates of depression.

Sex Differences in Stress Reactivity

Hierarchical multiple regression analyses tested the stress reactivity hypothesis that even at comparable levels of stress exposure, girls were more likely than boys to be depressed in response to stress. For all regressions, maternal depression status and sex were entered in the first step, stress was entered in the second step, and an interaction of sex and stress was entered in the last step. Standardized values of the stress variables were used to yield more interpretable odds ratios. Interaction terms were also computed using standardized stress values. Maternal depression status and sex both significantly predicted depression in the expected directions, $B = .84$, standard error (SE) = .25, odds ratio

Table 2. *Mediation Analyses With Regression to Examine Stress Exposure as an Explanation for Sex Difference in Depression*

Predictor	B	SE	Wald	OR
Sex → Dep				
Maternal Depression Status	0.83	0.25	10.87**	2.30
Sex	0.72	0.26	7.83*	2.05
Total Episodic Stress as the Mediator				
Sex → Total Episodic Stress	1.58	0.27	5.78**	NA
Total Episodic Stress → Depression	0.57	0.11	26.23**	1.78
Sex, after controlling for Total Episodic Stress	0.49	0.27	3.37+	1.63
Episodic Interpersonal Stress as the Mediator				
Sex → Episodic Interpersonal Stress	1.33	0.19	7.20**	NA
Episodic Interpersonal Stress → Depression	0.51	0.10	25.04**	1.67
Sex, after controlling for Episodic Interpersonal Stress	0.45	0.27	2.77+	1.56
Episodic Dependent Interpersonal Stress as the Mediator				
Sex → Episodic Dependent Interpersonal Stress	0.69	0.14	4.86**	NA
Episodic Dependent Interpersonal Stress → Depression	0.40	0.10	14.94**	1.49
Sex, after controlling for Episodic Dependent Interpersonal Stress	0.58	0.26	4.88*	1.78
Chronic Romantic Stress as the Mediator				
Sex → Chronic Romantic Stress	0.10	0.03	3.74**	NA
Chronic Romantic Stress → Depression	0.28	0.10	7.83*	1.32
Sex, after controlling for Chronic Romantic Stress	0.82	0.26	9.85**	2.28

$^+p <.10$. $^*p < .05$. $^{**}p < .01$.

(OR) = 2.31, $p < .01$, and $B = .72$, $SE = .26$, OR = 2.06, $p < .05$, respectively. Controlling for maternal depression status and sex, higher levels of each type of episodic and chronic stress predicted higher rates of depression (see Table 3).

Reactivity to total episodic and chronic stress. The interaction of sex and total episodic stress marginally predicted depression, $B = .49$, $SE = .26$, OR = 1.63, $p < .06$. Whereas total episodic stress predicted depression in girls, $B = .68$, $SE = .14$, OR = 1.98, $p < .001$, it did not predict depression in boys, $B = .20$, $SE = .21$, OR = 1.21, ns. The results suggest that girls were reactive to total episodic stress levels, whereas the boys exhibited low rates of depression whether under high or low episodic stress. This pattern of stress reactivity was not found for total chronic stress. Total chronic stress did not predict differential rates of depression for boys versus girls, $B = -.16$, $SE = .23$, OR = .85, ns.

Reactivity to interpersonal stress. The stress reactivity hypothesis was supported for episodic interpersonal stress (see Figure 1), and a trend in the expected direction was demonstrated for episodic dependent interpersonal stress, $B = 5.27$, $SE = .65$, OR = 1.91, $p < .05$ and $B = .45$, $SE = .26$, OR = 1.57, $p < .09$, respectively. Girls were reactive to both types of interpersonal stress whereas boys were not. Higher levels of

Table 3. *Sex Differences in Stress Reactivity to Interpersonal and Noninterpersonal Episodic and Chronic Stress*

Predictor	B	SE	Wald	OR
Block 1: Maternal Depression Status	0.84	0.25	10.98**	2.31
Sex	0.72	0.26	7.92*	2.06
Total Episodic Stress				
Block 2: Stress	0.53	0.12	21.13**	1.69
Block 3: Sex × Stress	0.49	0.26	3.59++	1.63
Total Chronic Stress				
Block 2: Stress	0.87	0.12	56.61**	2.39
Block 3: Sex × Stress	−0.16	0.23	<1	0.85
Interpersonal				
Episodic Interpersonal Stress				
Block 2: Stress	0.45	0.11	18.99**	1.59
Block 3: Sex × Stress	0.65	0.28	5.27*	1.91
Episodic Dependent Interpersonal Stress				
Block 2: Stress	0.35	0.11	11.31**	1.42
Block 3: Sex × Stress	0.45	0.26	3.00+	1.57
Chronic Stress				
Interpersonal Composite				
Block 2: Stress	0.85	0.11	55.66**	2.34
Block 3: Sex × Stress	−0.23	0.23	1.07	0.79
Close Friendship				
Block 2: Stress	0.32	0.10	10.26**	1.38
Block 3: Sex × Stress	−0.16	0.20	<1	0.86
Romantic Relationship				
Block 2: Stress	0.45	0.11	17.58**	1.56
Block 3: Sex × Stress	0.19	0.25	<1	1.21
Social Circle				
Block 2: Stress	0.45	0.11	18.13**	1.56
Block 3: Sex × Stress	−0.47	0.21	4.77*	0.63
Family				
Block 2: Stress	0.92	0.12	62.03**	2.51
Block 3: Sex × Stress	−0.34	0.24	1.94	0.72
Noninterpersonal				
Noninterpersonal Stress				
Block 2: Stress	0.25	0.11	4.90*	1.28
Block 3: Sex × Stress	0.02	0.24	<1	1.02
Chronic Stress				
Academic Composite				
Block 2: Stress	0.55	0.11	24.32**	1.73
Block 3: Sex × Stress	−0.23	0.22	1.06	0.78
Academic Performance				
Block 2: Stress	0.46	0.12	14.62**	1.58
Block 3: Sex × Stress	−0.11	0.24	<1	0.90
School Behavior				
Block 2: Stress	0.52	0.10	25.95**	1.68
Block 3: Sex × Stress	−0.26	0.20	1.60	0.77

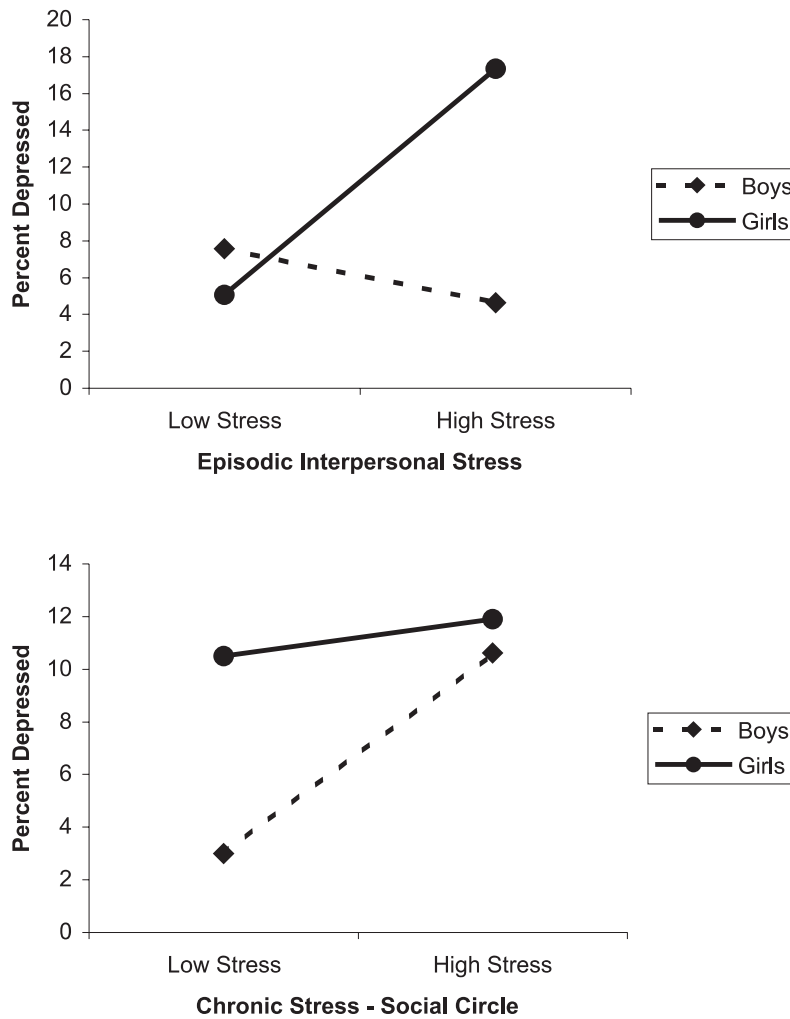+$p < .09$. ++$p < .06$. *$p < .05$. **$p < .01$.

Figure 1.   Sex differences in stress reactivity for episodic interpersonal and chronic peer relationship stress.

interpersonal and dependent interpersonal stress predicted depression in girls, $B = .62$, $SE = .13$, $OR = 1.86$, $p < .001$ and $B = .47$, $SE = .13$, $OR = 1.60$, $p < .001$. Higher levels of interpersonal and dependent interpersonal stress did not predict depression in boys, $B = -.03$, $SE = .25$, $OR = .97$, ns and $B = .02$, $SE = .23$, $OR = 1.01$, ns.

Differential sex reactivity to chronic interpersonal stress was also examined (see Table 3). A significant sex by stress interaction emerged only for chronic stress in the peer relations domain. The pattern of this interaction stands in contrast to our original hypothesis. Adolescent girls were not reactive to higher levels of chronic social circle stress, whereas boys were more reactive (see Figure 1). Adolescent girls reporting higher levels of chronic social circle stress were not more likely to be currently depressed than those reporting lower levels of stress, $B = .21$, $SE = .15$, $OR = 1.24$, ns. Adolescent boys, on the other hand, showed higher rates of depression for those who experienced high but not low levels of chronic social circle stress, $B = .70$, $SE = .16$, $OR = 2.02$, $p < .001$.

Reactivity to noninterpersonal stress.   In the noninterpersonal domain, girls were not more reactive to high levels of noninterpersonal stress compared to boys, $B = .02$, $SE = .24$, $OR = 1.02$, ns. Similarly, adolescent boys and girls did not differ in their reactivity to chronic stress in the domains of academic performance and school behavior, $B = -.11$, $SE = .24$, $OR = .90$, ns $B = -.26$, $SE = .20$, $OR = .77$, ns.

Discussion

This study examined sex differences in stress exposure and stress reactivity for both episodic and chronic stressors in interpersonal and noninterpersonal domains. The primary purposes of the study were to determine the roles of chronic and episodic stress and the importance of the interpersonal domain in the understanding of the sex differences seen in rates of depression in adolescence.

As predicted, adolescent girls experienced higher levels of exposure to overall episodic stressors, and the

effect was driven by girls' elevations in episodic stress in the interpersonal domain. These findings parallel other studies that found that girls experience higher levels of negative life events (Allgood-Merten et al., 1990; Ge et al., 1994), particularly interpersonal stressors (Gore et al., 1993; Larson & Ham, 1993, Rudolph & Hammen, 1999). Researchers have proposed that girls' higher levels of stress may be due to their lower level of social status and power (Nolen-Hoeksema, 2002). Another possibility is that girls are more likely to engage in behaviors or social situations that contribute to stressors in their lives. Indeed, this study found support for the specific stress generation hypothesis that adolescent girls contribute, in part, to higher levels of interpersonal stressful events, paralleling results reported by Rudolph and Hammen (1999).

Although girls experienced more episodic stress, boys reported higher total levels of chronic stress compared to girls, though the effect was small (ES = .14). The unpredicted finding that boys experienced higher levels of overall chronic stress is contrary to Nolen-Hoeksema et al.'s (1999) finding that adult women experience more chronic stress than men. Given this discrepancy, it is possible that sex effects on chronic stress are different in adolescence than in adulthood. Alternatively, this difference may be related to the different ways in which the studies assessed chronic stress, as Nolen-Hoeksema et al.'s measure emphasized strains that tend to be associated with the female role, such as lack of affirmation in close relationships, role burden, housework inequities, child care inequities, and other parenting strains. There are also differences between this study's chronic strain findings and those from the hassles literature. Although the finding that boys experience more school-related chronic stress parallels some hassles research (Heubeck & O'Sullivan, 1998), the findings that boys experience more close friendship stress and overall chronic stress are contrary to the hassles literature (Hastings et al., 1996; Heubeck & O'Sullivan, 1998; Lai et al., 1996). The difference between the hassles findings and our chronic stress findings may indicate that although girls have higher levels of minor, unpleasant experiences on a day-to-day basis, they are actually less likely to report enduring stressful circumstances. This study makes a novel contribution to the literature by examining sex differences in chronic stressful circumstances in an adolescent sample, but more studies that explicitly assess chronic stress are needed to confirm our results.

We also found support for a mediation hypothesis that the higher levels of stress exposure would explain the higher rates of depression observed in girls. Overall, total episodic stress explained a significant portion of sex's effect on depression rates. However, much of the mediated effect for total episodic stress was derived from the effect of interpersonal stress. Furthermore, not only did adolescent girls experience higher levels

of stress to which they in part contributed, dependent interpersonal stress also served as a significant mediator in explaining the greater rates of current depression among adolescent girls. Overall, the findings support increased stress exposure, particularly stressors that are interpersonal and episodic in nature, as an explanation for why adolescent girls are more likely to be depressed compared to adolescent boys.

Lastly, the stress reactivity findings yielded partial support of predictions. Both episodic and chronic stress predicted higher levels of depression. In support of our hypothesis that interpersonal domain is more important to girls, the findings demonstrated that girls were more reactive to episodic stress compared to boys, particularly in the interpersonal domain. Adolescent girls were reactive to high levels of interpersonal episodic stress, whereas adolescent boys were unlikely to be depressed at high or low levels of such stress. In contrast, adolescent boys and girls did not differ in their reactivity to most chronic stress types in both interpersonal and noninterpersonal (academic) domains.

The fact that girls displayed heightened stress reactivity especially to interpersonal episodic stress compared to boys likely reflects the combined influences of physiological, psychological, and social processes. Consistent with these findings, a number of theories have proposed sex differences in relational orientation (e.g., Arieti & Bemporad, 1980; Beck, 1987; Blatt, 1990; Gore et al., 1993). These theories propose that girls are more likely to have relational orientation styles characterized by an emphasis on the maintenance of stable and harmonious interpersonal relationships. Boys, on the other hand, are more likely to have relational orientation styles characterized by concerns about independence and competition as well as goal attainment. It would be important for future studies to examine whether the content of relational orientations is an explanation for why girls experience higher levels of depression in response to interpersonal stress. Furthermore, this study did not find that boys were more reactive than girls to stress in the noninterpersonal or achievement domain. The findings from Leadbeater et al.'s (1995) review parallel that of these findings in that they found girls to be more reactive to events that involve their interpersonal network whereas they did not find sex differences in reactivity to stressful events involving issues of self-worth. Nonetheless, adolescent boys' greater exposure to noninterpersonal chronic stress, as evidenced by the higher levels of chronic academic and school stress in this study, may be an important factor to consider for understanding predictors of depression in boys.

However, adolescent boys in this study showed greater reactivity to chronic stress in the social-circle domain. In this case, adolescent girls had higher levels of depression (compared to boys) at both low and high levels of chronic social-circle stress, but boys showed

significantly higher rates of depression in the presence of high chronic social-circle stress. The finding is contrary to our original predictions. However, Rudolph (2002) noted that girls' tendency to engage in close dyadic relationships and boys' tendency to socialize within larger peer groups may predict differential reactions to stressors that change the nature of close relationships for girls and peer status for boys. In this study, social-circle stress is more akin to the kind of peer-status stress that Rudolph proposed would be more detrimental for boys, whereas close friendship stress would be akin to the dyadic relationship stress that would be more detrimental for girls. Within this framework, it makes sense that boys were reactive to the social-circle stress whereas girls were not.

In sum, for both the stress exposure and stress reactivity hypotheses, interpersonal episodic stress emerged as a significant factor in understanding the sex difference in depression. It is important to note that although chronic stress did not significantly predict sex differences in the likelihood of depression in adolescents, it was a significant predictor of depression for both boys and girls. In this study, both episodic and chronic stress significantly predicted greater likelihood of depression in adolescents. This finding parallels that of research in other samples that demonstrate the importance of both episodic and chronic stress in predicting depression (e.g., Daley, Hammen, & Rao, 2000; McGonagle & Kessler, 1990; for reviews see Brown & Harris, 1989; Hammen, 2005; Mazure, 1998). However, these findings support the notion that episodic stress is a more important factor than chronic stress in explaining the sex difference in likelihood of depression.

Several caveats should be noted in the evaluation of these preliminary findings. First, the sample was predominantly Caucasian, and all were 15 years old, thereby limiting the generalizability of the findings to a more diverse sample of adolescents. Further, although the sample of boys was large, the sample of currently depressed boys and girls was small, and it would be important to examine a larger group of youths with depression. The study was cross-sectional, and longitudinal examinations of the association between stress and depression would be preferable. However, this study examined chronic and episodic stressors from 6 months to 1 year prior to current depression. Although we cannot be certain that the youth were "reactive" to stressors in a strictly causal sense, the great majority of episodic stressors, and possibly most of the chronic stressors, predated the onset of current depressive episodes. Finally, the sample included a disproportionate number of youths of depressed mothers who were selected into the study. Although the effect of maternal depression on youth stress and depression was controlled statistically in the analyses, it is possible that results would not generalize to unselected community samples. In addition, an alternative to controlling for maternal depression would be to consider its role more centrally, which was beyond the scope of this article. Future studies might benefit from examining the impact of maternal depression on sex differences in stress and depression.

As with most of the other studies in this area, it is unclear whether there is a sex bias in the reporting of various episodic stressors. Although the findings suggested higher stress exposure for girls than boys in most subtypes of episodic stress, it is possible that the effect is due in part to sex differences in stress reporting rather than actual stress exposure. The study design cannot rule out the possibility that boys simply do not report episodic events as readily as girls do. However, the use of the life stress interview extracts some of the subjectivity of the stress-reporting process. The semi-structured life stress interview elicited discussions of recent circumstances in which episodic events could be identified and queried by the interviewer, as well as standard probes of possible life-event content. This method of probing did not rely on youths' judgment of whether an event was stressful or how stressful an event was, but on their description of recent life circumstances. There is no reason to expect boys and girls would differ in their memories of recent events and circumstances, so it was unlikely that girls' reports of more life events in this study were merely an artifact of the methodology. Furthermore, the finding that girls did not report higher levels of stress across all domains and that boys reported higher levels of chronic stress compared to girls suggests that boys were probably not underreporting their stress levels.

These caveats aside, stress exposure and stress reactivity processes have been shown to be significant factors that aid our understanding of sex differences in depression. Additional studies are needed to further elucidate the social, psychological, and physiological processes that underlie the sex differences in stress reactivity. Furthermore, the finding that girls had higher levels of interpersonal events to which they had contributed may suggest a modifiable source of vulnerability to depression. It remains for future research to more fully characterize the processes through which stress generation occurs. A better understanding of these processes will likely play a significant role in furthering the development of prevention and treatment programs for depression.

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