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Differential Relations Between Youth Internalizing/Externalizing Problems and Cortisol Responses to Performance vs. Interpersonal Stress

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Abstract

Efforts to define hypothalamic-pituitary-adrenal (HPA) axis profiles conferring risk for psychopathology have yielded inconclusive results, perhaps in part due to limited assessment of the stress response. In particular, research has typically focused on HPA responses to performance tasks, while neglecting the interpersonal stressors that become salient during adolescence. In this study we investigated links between psychosocial adjustment—youth internalizing and externalizing problems, as well as competence—and HPA responses to both performance and interpersonal stressors in a normative sample of children and adolescents. Participants ($n = 59$) completed a set of performance (public speaking, mental arithmetic, mirror tracing) and/or interpersonal (peer rejection) tasks and gave 9 saliva samples, which were assayed for cortisol. Hierarchical linear models of cortisol response trajectories in relation to CBCL scores revealed stressor- and sex-specific associations. Whereas internalizing problems related to earlier peaking, less dynamic cortisol responses to interpersonal stress (across males and females), externalizing problems related to lower, earlier peaking, and less dynamic cortisol responses to performance stress for males only, and competence related to later peaking cortisol responses to interpersonal stress for females only. Implications for understanding contextual stress profiles underlying different forms of psychopathology are discussed.

Keywords

HPA Axis; Cortisol; Internalizing; Externalizing; Performance Stress; Interpersonal Stress; Youth

Problematic stress responding is linked to mental health difficulties, yet efforts to characterize physiological “dysregulation” underlying internalizing and externalizing problems have been inconclusive.^{1–3} In part, this failure may be due to limitations in assessment of the stress response; most previous studies have examined reactivity to a single performance stress task, with less attention to interpersonal stressors. During adolescence,

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Declaration of Interest

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the latter type of stress may be particularly relevant as social acceptance becomes a salient goal. The current investigation aimed to clarify stress profiles underlying emergent risk for psychopathology by testing associations between youth adjustment—internalizing and externalizing problems and psychosocial competence—and hypothalamic-pituitary-adrenal (HPA) axis responses to both performance and interpersonal stressors.

Internalizing difficulties have been proposed to stem from HPA axis hyperactivation, and externalizing difficulties from hypoactivation.⁴ Research on diurnal cortisol in both the general population and clinically identified samples has demonstrated associations between internalizing problems and elevated morning cortisol, and between externalizing problems and low basal cortisol.^{1, 5–8} Some research on child/adolescent cortisol in response to stress also supports this proposal, including studies of both non-clinical (subthreshold symptoms)² and clinically identified groups (those with a DSM diagnosis).^{4,9} However, other researchers dealing with community samples that include a range of subclinical and clinical-level symptoms have reported no association,^{1,10–11} or links between both internalizing/externalizing and greater task-related cortisol declines.¹² The literature for competence is similarly mixed, with elevated child/adolescent cortisol reactivity related to both higher^{13–14} and lower¹⁵ competence. A contextual moderator that has yet to be tested is stressor type. Previous research suggests youth responses to performance compared to interpersonal (peer rejection) stressors develop along unique paths.¹⁶ The demands of different stressors may highlight different areas of adjustment difficulty, and examining reactivity to only one task could miss effects detectable in another situation.

In efforts to define variations in youth cortisol responses related to both psychosocial difficulties and strengths, it is critical to consider sex differences. There is converging evidence from behavioral and biological research that females are typically more sensitive to affiliative threat.^{17–18} In line with this idea, adult women have shown greater cortisol reactivity to an interpersonal challenge (peer rejection) task, whereas men showed greater reactivity to a performance task.¹⁹ In adolescents, we might expect the importance of peer acceptance to be heightened for both males and females, fostering sex equivalence. On the other hand, differential sensitivity to interpersonal stressors that become more common in puberty is thought to contribute to a female preponderance in internalizing disorders at this time.²⁰ One study showed a stronger association between adolescent girls' internalizing problems and cortisol reactivity to a combined interpersonal/performance task.²¹ Although these results support a female-specific link between interpersonal stress and adjustment, this has yet to be tested directly with separate interpersonal and performance stressors.

The current study tested stressor- and sex-specific relations between cortisol responses and adjustment in a community sample of normally developing youth. Other work in this sample aims to clarify pubertal effects on cortisol reactivity to performance vs. interpersonal stressors.²² The present study builds on this work by investigating variations in cortisol response related to youth adjustment. We hypothesized (1) internalizing/externalizing problems and competence would relate differently to youth responses to performance vs. interpersonal stressors; (2) more evidence of hyperactivation related to internalizing and hypoactivation to externalizing problems; and (3) sex differences—stronger effects for females during interpersonal, and males during performance, tasks.

Method

Participants

Participants were 59 children and adolescents aged 8–17 ($M = 12.59$, $SD = 2.56$) participating in a larger study of sex differences in physiological responses to stress over the pubertal transition,²² representing a range of pubertal development (median Tanner stage III), and split relatively evenly between males (42.4%) and females (57.6%). The majority of participants were White (62.7%), with smaller proportions identifying as Latino/a (27.1%), Black (5.1%), or Asian (5.1%). Youth were recruited through community and online postings and screened for exclusion criteria; these included use of medications known to influence cortisol reactivity (i.e., oral contraceptives, thyroid medications, steroids, and psychotropic medications), as well as psychiatric diagnoses and neurodevelopmental diagnoses that could interfere with participation such as autism or mental retardation, and current physical illness.

Procedures

All study procedures were approved by the Brown Medical School Institutional Review Board. Parents gave informed consent, and youth gave assent, to all procedures prior to participation. The study involved three 2-hr sessions on separate days, each beginning during a specified afternoon time interval (2–5pm) to control for diurnal variation in HPA axis function. During an initial “rest” session designed to habituate participants to the laboratory and saliva sampling procedures, they watched G-rated movies and television shows and completed questionnaires. The ensuing “stress” sessions involved performance tasks or interpersonal (peer rejection) tasks, administered in random sequence. In the first phase of the study, 16 participants were invited to take part in one stress session only ($n=13$ performance, $n=3$ interpersonal). In the later phase, 43 participants were invited to take part in two stress sessions; six did not continue after the first session ($n=4$ performance, $n=2$ interpersonal), leaving 37 who completed both and 22 who completed one session.

Participants were asked to avoid food and drink (except water), exercise, and caffeine for an hour before stress sessions. For both types of sessions, a 30-minute baseline period was followed by three stress tasks (10 minutes, 5 minutes, and 5 minutes), and then a 60-minute recovery period. During baseline and recovery, participants watched G-rated movies and television shows. Over the course of the session, nine saliva samples were collected to measure cortisol stress responses (see Figure 1 for timing details). Participants were debriefed both alone and with their parent, and they concluded with a positive interaction with confederates/audience before being compensated for their time.

Performance stress tasks—These tasks were adapted from the Trier Social Stress Test for Children (TSST-C)²³ and included (1) public speaking (participant was given 5 minutes to prepare and then 5 minutes to speak on academic topics, with difficulty adjusted based on participant age); (2) mental arithmetic (5 minutes of serial subtraction under time pressure, again with difficulty adjusted based on age/performance); and (3) mirror star tracing (5 minutes of tracing a six-sided star while viewing only its mirror image, with errors counted

and marked by sound/light).²⁴ Tasks were performed in front of a two-member audience who maintained a stern expression during the procedure.

Interpersonal stress tasks—These tasks were adapted for children and adolescents from the Yale Interpersonal Stressor (YIPS).¹⁹ The YIPS-Child Version involved a series of interactions with two trained age- and sex-matched confederates who subtly excluded the participant by bonding with each other, leaving the participant out of their conversations, and espousing different interests and activities than the participant. Participants were told they were to discuss specified topics while “getting to know one another”; interaction segments focused on (1) introductions and weekend activities (10 minutes), (2) family (5 minutes), and (3) friends (5 minutes). Exclusion—via both verbal and nonverbal cues—built gradually over the course of the three segments.

Measures

Cortisol—Nine whole saliva samples were collected over the course of each stress session and frozen at -80°C until shipment on dry ice for assay. Free cortisol concentrations were measured using a commercially available chemiluminescence-immuno-assay (CLIA) with high sensitivity (0.16 ng/ml; IBL, Hamburg, Germany). Intra- and inter-assay coefficients of variation were $< 8\%$. Cortisol scores were natural log-transformed to correct for positive skew prior to analysis.

Child Behavior Checklist 6–18 (CBCL)—The CBCL is a widely used parent-report measure of child/adolescent behavioral adjustment.²⁵ Parents rate 113 behaviors along a 3-point Likert scale (0 = “not at all true,” to 2 = “very true”) to yield eight problem behavior subscales and two broadband scales. The Internalizing broadband score is based on Anxious/Depressed, Withdrawn/Depressed, and Somatic Complaints subscales, whereas the Externalizing broadband score is based on Rule Breaking and Aggressive Behavior subscales. Finally, the Competence broadband score is based on Activities, Social, and School subscales. Test-retest reliability and internal consistency of both broadband scales and subscales have been shown to be excellent.²⁵ Broadband problem scale *T*-scores ranged from 27 to 78, with relatively few participants showing clinically elevated Internalizing (6.8%) or Externalizing (3.4%) scores ($T \geq 65$). Due to restricted range of the *T*-score distributions and the non-clinical nature of this sample, raw CBCL scale scores (log-transformed to correct for positive skew as necessary) were used in analyses.

Analytic Strategy

The data under investigation are dependent (i.e., multiple cortisol scores over time clustered within an individual). Therefore, hierarchical linear modeling (HLM)²⁶ was selected to model youth cortisol trajectories across both performance and interpersonal stress sessions. Level 1 modeled within-person variation in cortisol over time with growth parameters that were allowed to vary across participants. At Level 2, between-person variability in these growth parameters could be explained by youth adjustment. All adjustment effects were continuous, based on CBCL scale scores. An advantage of HLM is that it allows missing data at Level 1 while using full information maximum likelihood estimation to arrive at

parameter estimates; thus, models were based on all 59 participants' data even though not all participants completed both stress sessions.

First, baseline models with no explanatory predictors were fit, providing a description of average cortisol response trajectories in each stress session. Next, participant CBCL scores were entered as predictors of variability in cortisol trajectory components. Participant sex and sex $\times$ CBCL terms were also tested to determine if effects varied across males and females. Separate models were created to address internalizing, externalizing, and competence effects.¹ Growth curve models included stressor-specific intercepts (centered so as to represent cortisol levels at the beginning of the second stress task within each session), slopes (the instantaneous rate of change of the curve at the beginning of the second stressor, represented by time), and quadratic terms (the acceleration/deceleration describing steepness of the overall trajectory curve, represented by time²).

For illustration, the 2-level equation used to assess relations between externalizing problems and cortisol responses is given below. Whereas the Level 1 equation explains repeated measures of each participant's cortisol via growth curves during performance and/or interpersonal stress sessions, Level 2 explains individual differences in these curves across participants:

Level 1

$$\text{Cortisol} = \text{Performance} [\beta_{0P} + \beta_{1P}(\text{time}) + \beta_{2P}(\text{time}^2)] + \text{Interpersonal} [\beta_{0I} + \beta_{1I}(\text{time}) + \beta_{2I}(\text{time}^2)] + \text{error}$$

Level 2

$$\beta_{0P} = \gamma_{00P} + \gamma_{01P}(\text{male}) + \gamma_{02P}(\text{CBCL Externalizing}) + \gamma_{03P}(\text{male} \times \text{CBCL Externalizing}) + \text{error}$$

(similar equations used to predict β_{1P} – β_{2P} and β_{0I} – β_{2I})

Results

Baseline Model and Controls

The baseline HLM model revealed higher cortisol levels (intercept term) during the performance, compared to interpersonal, stress session, $\chi^2(2) = 432.77$, $p < .001$. Participants showed decreasing cortisol levels (negative linear term/recovery) following both stress tasks, though this was more pronounced in the interpersonal stress session, $\chi^2(2) = 91.16$, $p < .001$. Finally, the overall dynamic of rising and falling cortisol (quadratic term) across the session was more pronounced in the performance stress session, $\chi^2(2) = 40.58$, $p < .001$. At the same time, significant between-participant variability in all of these parameters, $\chi^2(34) = 108.41 - 1824.97$, all $p < .001$, suggested individual differences in

¹A model containing both Internalizing and Externalizing scores simultaneously was also run to determine whether effects could be attributed to unique problem dimensions, or to shared variance between the two. All effects reported below were unchanged—same pattern of significant effects, all coefficients within 98% confidence interval of the original—suggesting that they were not influenced by overlap between internalizing and externalizing difficulties.

performance and interpersonal stress trajectories that could be predicted by youth adjustment.

A number of possible control variables were tested, including child age and pubertal development,² BMI, medication use and health, race, and SES. Of these, SES related to higher cortisol levels during the performance stressor, and BMI related to higher cortisol levels and a later peak (more positive linear term) during the interpersonal stressor. The results reported below were unaltered by the inclusion of these control variables (all coefficients within the 98% confidence interval of original estimate), so the simpler models including the same set of hypothesized predictors for both sessions are reported. Of the adjustment predictors to be tested, Competence was unrelated to problem behavior scores ($r = -.08$ for Internalizing and $-.03$ for Externalizing, both *ns*), whereas problem dimensions were positively associated with one another ($r = .49, p < .001$).

Explanatory Models

First, broadband scale scores—i.e., Internalizing, Externalizing, and Competence—were examined as separate predictors of youth cortisol trajectories across sessions. Participant sex was included in all models and examined as a potential moderator of adjustment effects. Next, if one or more significant effects involving a broadband scale was found, further models with subscale scores were run to clarify the source of effects.

Internalizing scores were found to predict an earlier cortisol peak (more negative linear term) in the interpersonal stress session, as well as a less dynamic overall response curve (more positive quadratic term; see Figure 2). These effects were not qualified by interactions with participant sex, though there was a main effect of sex on the interpersonal stress linear term, and there were no effects involving the performance stress response (see Table 1, top panel). Including these predictors resulted in a significant improvement in model fit compared to baseline, according to the deviance statistic, $\chi^2(3) = 15.07, p < .01$. The Internalizing model explained 23.5% of the variance in linear and 16.7% of the variance in quadratic terms for the interpersonal stress session.

Externalizing score effects, by contrast, were sex-specific; males with more externalizing problems showed lower cortisol levels during the performance stressor, as well as an earlier peak (more negative linear term) and a less dynamic response curve (more positive quadratic term; see Figure 3). No effects involving the interpersonal stress response were found (see Table 1, middle panel). Again, including these predictors offered a significantly better model fit compared to baseline, $\chi^2(10) = 19.68, p < .05$. The Externalizing model explained 10.7% of the variance in intercepts, 17.4% of the variance in linear terms, and 10.3% of the variance in quadratic terms for the performance stress session.

Finally, Competence scores predicted a later cortisol peak (more positive linear term) during the interpersonal stress session for females only (no effects involving performance stress response; see Table 1, bottom panel, and Figure 4). The inclusion of these predictors once

²Only main effects were tested here; age $\times$ sex interaction effects constitute the focus of another manuscript using this sample (Stroud et al., under review).

again yielded a significant fit improvement compared to baseline, $\chi^2(3) = 14.75, p < .01$. The Competence model explained 39.5% of the variance in linear terms for the interpersonal stress session.

Examination of individual subscales revealed that the Internalizing effect on interpersonal stress cortisol response curves was driven by both anxiety and withdrawal (see Table 1, top panel indented lines). Anxiety additionally related to higher cortisol levels during the performance stressor (across males and females), with a later cortisol peak and more rapidly changing response curve during this session for females only. Of the Externalizing subscales, both rule breaking and aggression contributed to the sex-specific effects on performance stress cortisol levels and dynamics described above (see Table 1, middle panel indented lines). Aggression additionally related to a later cortisol peak during the interpersonal stress session for females only. Finally, the Competence effect on interpersonal stress cortisol dynamics was found to be driven by the activities subscale (see Table 1, bottom panel indented lines).

Overall, these models point to a dynamic rising and falling cortisol response peaking close to the stress exposure itself (as opposed to an anticipatory peak) in youth with superior psychosocial adjustment. Results provided partial support for the proposal that externalizing problems relate to lower, and internalizing problems to higher, cortisol levels during stress exposure. Whereas internalizing problem and competence effects were most evident for females and in response to interpersonal stress, externalizing problem effects were strongest for males and in response to performance stress.

Discussion

This study aimed to clarify contextual implications of the HPA stress response for psychosocial adjustment by examining youths' cortisol during both performance and interpersonal stressors. As predicted, individual differences in response related to internalizing/externalizing problems and competence depended on both the stressor type and youth sex.

Stressor-specific adjustment effects underline the importance of considering youth regulation in different stress contexts. Although caution must be used in extrapolating from the current findings (in a non-clinical sample) to clinical syndromes, the associations found here may point to pre-clinical processes underlying the development of such syndromes. Internalizing problems—including CBCL syndrome scales relevant to both anxiety and depression—were associated with an earlier cortisol peak and less dynamic response curve during the interpersonal stress session only. This adds to the argument that depression and related problems are most closely associated with a difficulty turning on and shutting off a stress response at the appropriate times, rather than a necessarily aberrant *level* of response. While acknowledging that other research has shown links between internalizing symptoms and cortisol during other types of stressors, this finding supports the more widespread consideration of interpersonal stressors in efforts to identify youth (both males and females) at risk for anxiety/depression.

Cortisol associations with other domains of adjustment were not only stressor-specific, but also sex-specific, highlighting differing risk profiles for girls vs. boys. Females with greater psychosocial competence—in particular, those who participated and showed skill in various activities—exhibited a later peaking cortisol response during the interpersonal stress session. The opposite of the pattern noted above, such a competence-related delay in cortisol reactivity could protect girls against internalizing syndromes. In line with behavioral and biological research on the emergence of sex differences, this may speak to a trend for interpersonal stress to matter more for females (compared to males) as they develop into adult roles.²² The present results suggest this trend is already detectable in late childhood/adolescence, which could be useful for the early detection and treatment of at-risk girls.

Male youth, on the other hand, showed differences in cortisol response to performance stress related to externalizing problems. Specifically, boys with more externalizing difficulties—both rule-breaking behaviors and aggression—showed lower cortisol levels, an earlier cortisol peak, and a less dynamic response curve during the performance stress session. This pattern is consistent with the characterization of externalizing as a syndrome of HPA hypoactivation (and a link between anxiety and higher girls' cortisol levels provided partial support for the other side—internalizing as a syndrome of HPA hyperactivation). It may be that the rule-bound demands of these stress tasks, compared to the looser constraints of the peer interaction tasks, are best suited to reveal young males' externalizing tendencies. It is interesting that the one externalizing effect noted for females—an association between aggressive behaviors and later-peaking cortisol during interpersonal stress—was similar to that observed for competence. These divergent behavioral correlates of the same cortisol profile suggest physiological arousal during rejection may have a range of consequences—on the one hand, motivating skillful behaviors to improve the situation (for girls who have learned to self-regulate), and on the other, fueling aggressive acting out (for girls with poorer self-regulation capacities and/or social learning history). More detailed investigation of factors moderating cortisol-adjustment associations will be needed to tease apart such effects.

Even as these results emphasize context-specificity in the interpretation of stress responses, it is worth noting points of commonality. Across males and females responding to performance and interpersonal stressors, a steeper cortisol response curve that peaked close to actual stress exposure (as opposed to well in advance) appeared optimal—i.e., related to lower internalizing and/or externalizing problems and to greater competence. Responses that are closely tied to the challenge itself—reflected in brief reactivity and lower activation during stress anticipation and recovery—may allow youth to manage stressor demands more effectively while avoiding the harmful consequences of sustained HPA activation. This common pattern underlines the importance of considering the dynamics of physiological response, and not just levels, to define stress-related health risks.

Limitations of this study should be used to inform future research. The current sample comprised normally developing youth, few of whom showed clinically significant internalizing or externalizing problems. Thus, they do not necessarily represent the general population, but rather the more well-adjusted end of the spectrum. Although this limited range of adjustment outcomes would be expected to blunt, rather than exaggerate, effects, it

will be important to test these models in the general population (which includes the full range of psychological adjustment) and in the higher-risk end of the spectrum (i.e., clinically referred youth and/or those at risk for disorder due to family history). While acknowledging this limitation, it is worth noting that youth internalizing and externalizing disorders are arguably best conceptualized on a continuum,^{27–28} and given that many studies focus on clinical samples, little is known about the association between HPA profiles and psychopathology symptoms at the “low-risk” end of the spectrum. This study contributes to that understanding and may help generate hypotheses regarding pathways from low symptomatology to more severe psychopathological manifestations across development.

The total sample size in this study was relatively small, which may have restricted power for detecting effects, including an expected effect of age/pubertal development on cortisol function. Other work in this sample suggests there are developmental shifts in stress responsiveness, but that these are sex-specific changes in relative response to performance vs. interpersonal stress rather than simple main effects.²² It would also be ideal to test whether stressor-specific response patterns detected here apply equally or more strongly to adults in whom disorder presentations are more established. As alluded to above, stressor type and sex are likely not the only moderators of interest in cortisol-adjustment associations, and further insight into risk profiles may come from simultaneously considering the broader social environment as proposed by Biological Sensitivity to Context theory and the related Adaptive Calibration Model.^{29–30}

This research suggests that relying solely on performance tasks to measure the stress response may obscure important domains of youth risk (i.e., internalizing problems) and resilience (i.e., females’ competence). It is our hope that these findings spur further consideration of how the stress context matters in the identification of emergent mental health difficulties.

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Figure 1.

Saliva sampling timeline.

Note. Numbered boxes indicate stress tasks (task 1 = 10 min, tasks 2 and 3 = 5 min + 3 min saliva sampling). Time from start of session noted in parentheses.

Figure 2.

Internalizing problems predict males' and females' cortisol responses to interpersonal stress.

Note. Int = CBCL Internalizing score; low = -1 *SD* and high = $+1$ *SD*.

Figure 3.
Externalizing problems predict males' cortisol responses to performance stress.
Note. Ext = CBCL Externalizing score; low = -1 *SD* and high = $+1$ *SD*.

Figure 4.

Competence predicts females' cortisol responses to interpersonal stress.

Note. Comp = CBCL Competence score; low = -1 *SD* and high = $+1$ *SD*.

Youth Adjustment Related to Cortisol Responses to Performance and Interpersonal Stressors

Table 1

	Performance Stress			Interpersonal Stress		
	Intercept γ, p	Linear γ, p	Quadratic γ, p	Intercept γ, p	Linear γ, p	Quadratic γ, p
Internalizing	.15, .207	.005, .644	-.007, .185	.007, .903	-.015, .024	.006, .008
Anxiety	.27, .003	.030, .003	-.017, .003	-.006, .934	.001, .928	.009, .010
Male	.33, .128	.004, .806	-.019, .046	.119, .486	-.043, .011	-.005, .438
Anxiety $\times$ Male	-.27, .193	-.039, .030	.019, .026	-.032, .789	-.024, .100	-.002, .692
Withdrawal	.18, .114	.0005, .957	-.003, .440	.043, .565	-.011, .215	.007, .013
Externalizing	.21, .100	.013, .309	-.008, .170	-.012, .861	.011, .215	.004, .378
Male	.28, .178	-.004, .795	-.015, .104	.10, .552	-.043, .018	-.004, .508
Externalizing $\times$ Male	-.43, .011	-.043, .005	.016, .037	-.029, .785	-.017, .208	-.002, .713
Aggression	.18, .197	.012, .383	-.007, .332	.053, .531	.022, .015	.002, .665
Male	.29, .162	-.002, .891	-.016, .085	.12, .494	-.042, .018	-.005, .455
Aggression $\times$ Male	-.40, .026	-.040, .012	.013, .119	-.086, .459	-.029, .029	-.0004, .945
Rule-Breaking	.21, .143	.011, .264	-.008, .242	-.12, .052	-.010, .366	.005, .214
Male	.25, .230	-.007, .693	-.013, .172	.068, .684	-.048, .006	-.004, .590
Rule-Breaking $\times$ Male	-.35, .047	-.044, .002	.021, .018	.031, .812	.007, .704	-.0009, .872
Competence	.11, .543	.0009, .947	-.006, .527	.13, .267	.039, .003	.001, .808
Male	.30, .165	.0004, .983	-.017, .084	.097, .549	-.045, .005	-.005, .453
Competence $\times$ Male	-.084, .687	.004, .829	-.001, .921	-.23, .195	-.036, .015	.001, .881
Activities	-.059, .743	.005, .733	-.007, .425	.096, .453	.035, .003	-.003, .579
Male	.30, .171	-1×10^{-5} , .999	-.015, .118	.090, .579	-.049, .004	-.005, .480
Activities $\times$ Male	.026, .903	-.004, .803	.003, .785	-.22, .201	-.037, .009	.009, .183

Note. CBCL variables are standardized (Z) scores. Participant sex-moderated effects shown for models in which one or more significant interactions was found. Significant effect ($p < .05$) highlighted in bold.