



Links Between School and Home: Associations Between Adolescent School Day Experiences and Maternal Perceptions of Family Relations

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Abstract

Research has historically under-emphasized adolescent contributions to family functioning. In this study, we examined how adolescents' day-to-day challenges in school — such as having problems with peers or teachers — may filter into family life, across family-level, mother–adolescent, and interparental relations. This study used daily diary data collected from 130 mother–adolescent dyads from two-caregiver households over a three-week period. Multilevel modeling was used to disentangle within- and between-family effects of adolescents' school day challenges (adolescent reports) for family functioning on the same day (mother reports). Adolescent gender was tested as a moderator of these effects. Findings indicated that adolescents' school day challenges were linked to family functioning. Between-family analyses indicated that adolescents with more school day challenges had poorer family functioning in each of the three domains. Additionally, several within-family associations were statistically significant. On days when adolescents experienced more challenges at school than usual, mothers reported increased conflict with their adolescents, diminished parenting practices, and less positive interactions with their partners. In addition, adolescent gender moderated an effect. On days when boys experienced more challenges at school than usual, mothers reported decreased family cohesion; these results did not hold for girls. Overall, the results highlight the value of considering how adolescents' experiences out of the home may impact family life. Links between adolescent daily experiences and family relations provide important insights into family processes for family researchers and practitioners.

Keywords Adolescence · Daily diary · Family process · Mother–child interactions · School stressors

Highlights

- Adolescent school day challenges are linked to maternal perceptions of family functioning across domains.
- On average, higher levels of school challenges were associated with poorer family relations, per mother reports.
- On days when adolescents experienced more challenges than usual, mothers also reported poor family relations.

The quality of family relations play a critical role in adolescent development (Campione-Barr and Smetana 2019). Research historically has emphasized the effect of parent factors (e.g., maternal depression) or parents' extrafamilial experiences (e.g., work stress) linked to adolescent development (Davila

et al. 2019; Hill and Holmes 2019). Further, prior research has demonstrated that family functioning can be directly linked to adolescent internalizing and externalizing behaviors across contexts (Luebbe and Bell 2014; Weymouth et al. 2016). Yet, a family systems perspective underscores the implicit interdependence and bidirectional links occurring between family members and subsystems, not singular parent-driven pathways (Minuchin 1985). Although it is recognized that adolescents' moods and behaviors are linked to family relations (Dishion and Patterson 2015; Serbin et al. 2015), much less attention is given to the extrafamilial experiences of adolescents, such as their school day experiences, that may also impact family functioning.

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To capture a wide range of family domains that may be linked to adolescent extrafamilial stressors, this study focuses on family-level, mother–adolescent, and interparental relations related to successful adolescent developmental outcomes. The first domain, *family-level relations*, is represented by family cohesion, which refers to general feelings of affection, support, and togetherness in the family as a whole (Barber and Buehler 1996). Family cohesion is a well-established protective factor against internalizing and externalizing behaviors during adolescence (Barber and Buehler 1996; Fosco et al. 2012; Luebbe and Bell 2014). The second domain, *mother–adolescent relations*, includes mother–adolescent closeness, conflict, and parenting practices. Mother–adolescent closeness and positive parenting have been associated with child reports of higher emotional adjustment across domains and lower internalizing behaviors (Ratelle et al. 2017; Serbin et al. 2015). Although some parent–adolescent conflict is normative, conflict-driven parent–child interactions have been associated with a variety of maladaptive psychological and behavioral outcomes (Steinberg and Silk 2002; Weymouth et al. 2016). The third domain, *interparental relations*, includes interparental positivity and conflict. Adolescents exposed to more frequent and intense conflict are at elevated risk for emotional and behavioral problems (Buehler et al. 1997; Fosco and Feinberg 2015). However, positive interparental relations have beneficial implications for adolescents' reduced psychopathology (Bradbury and Karney 2004; Davies et al. 2012; Schlomer et al. 2015). Although these domains are inter-related, theory and prior research emphasizes their distinctiveness and important implications for adolescent development (Fosco and LoBraico 2018; Fosco et al. 2012).

Families do not function in a vacuum; indeed, family health is intimately tied to the broader ecological context (Bronfenbrenner 1992; Minuchin 1985). Stressful experiences outside of the family, particularly those evoking strong negative affect, can filter into family life, shaping the way family members interact with one another at home (Erel and Burman 1995; Larson and Almeida 1999). Evidence for this idea is found across a range of literatures. Community violence is thought to destabilize family relationships (Fowler et al. 2009; Gorman-Smith et al. 2004; Overstreet and Mazza 2003). Similarly, financial strain and socioeconomic disadvantage have been linked to family relations (Masarik and Conger 2017). Even more routine stressors, such as daily work stress, has been found to make parents more prone to conflict-driven interactions associated with family relations (Crouter et al. 1999; Margolin and Christensen 1996; Repetti and Wang 2017). A common thread across these domains is that there is considerable evidence that adversity and/or stressors outside of the home can find their way into the home. Historical emphasis has

been placed on parents' transmission of extrafamilial stress into family life. Here, we seek to expand on the view that adolescents' stressful experiences outside of the home may also filter into family life.

Adolescent Influences on the Family

Considerable work underscores the important contributions adolescents make to family system functioning (Fuligni 2019; Serbin et al. 2015). Adolescents are particularly influential on family functioning as they become increasingly autonomous, cognitively sophisticated, and self-regulated in preparation for the challenges and demands of adulthood (Rowe et al. 2015; Wray-Lake et al. 2010). These changes prompt increased interest and motivation for adolescents to play larger roles in family decision making processes (Beveridge and Berg 2007; Serbin et al. 2015). In addition, adolescents are more likely to become involved in family disputes than younger children (Davies and Forman 2002). These developmental changes suggest that adolescents are more influential in family functioning than in earlier childhood.

Developmentally, adolescents experience more school-related stressors as expectations for their behavior and success at school increases, compared to earlier in life (de Anda et al. 2000; Hampel and Petermann 2005; Raufelder et al. 2014). Indeed, adolescents engage in numerous interpersonal interactions with their teachers and peers throughout the school day that have increasing importance for their development and well-being. Stressful or challenging interactions with teachers have been associated with lower academic motivation, school attachment, and behavioral problems (DeSantis King et al. 2006; Gehlbach et al. 2012; Hallinan and Dame 2013), and may be negatively associated with overall adolescent school day experiences. Additionally, peer relationships take on new importance during adolescence, and experiences of peer conflict at school may be negatively associated with adolescents' school day experiences, affecting how they later engage in routine family interactions at home (Chung et al. 2011; Laursen et al. 1996). Although supportive peer relationships have been linked to increased social competence and social skills (Smetana et al. 2006; Wang and Eccles 2012), peer conflict or rejection has been associated with corumination, depression, and anxiety (Dishion and Tipsord 2011; Vanucci et al. 2018). Thus, it seems that the school day is a potent context for challenges and stressors that may come home with an adolescent.

Preliminary evidence, drawn from daily diary studies that collected data from between two days to two weeks, documents how adolescents' experiences at school may relate to conflict at home (Chung et al. 2011; Flook and

Fulgini 2008; Repetti 1996). In middle to late childhood, daily challenges with teachers and peers at school, were associated with more aversive parent–child interactions at home (Repetti 1996). A similar pattern of findings was demonstrated in later developmental periods. For ninth grade students, studies have shown links between adolescents' experiences of problems at school and peer conflicts with increased experiences of family conflict at home (Chung et al. 2011; Flook and Fuligni 2008). These findings provide evidence supporting the idea that adolescent school day experiences may lead to conflict at home. This work is limited by two factors. First, it has relied on single-reporter data, which is vulnerable to biases. Work drawing on multiple reporters (e.g., adolescent report of school day stressors and parent report of family relations) would provide an even stronger empirical base for the transmission of stress to the family (Larson and Almeida 1999). Second, this work has focused on family conflict outcomes, leaving less clear how adolescent stressors may impact other important domains of family functioning.

Other work, incorporating multiple reporters and domains of family relations have provided inconsistent evidence linking school stressors and family functioning. Using multi-informant data collected from adolescents and their parents, Timmons and Margolin (2015) found that adolescent reports of negative events at school were associated with daily variation in parent reports of parent–child conflict; although findings were less robust in cross-informant models than in those averaging parent and adolescent reports of the family. In other studies, findings fail to document a link between adolescent-reported school day experiences and parent-reported warmth and conflict with their adolescent (Bai et al. 2016; Lehman and Repetti 2007). In both studies, mono-informant models using adolescent reports of stressors and family functioning did reveal significant effects (e.g., diminished parental warmth, increased parent–child conflict on stressful school days). Due to limited statistical power (e.g., sample $N < 100$ or limited number of school days), it is unclear whether inconsistencies in mono- and cross-informant designs reflect expected differences in the magnitude of effects found, or if the findings do not hold in cross-reporter models (Bolger and Laurenceau 2013). Thus, it is necessary to re-visit these questions using cross-reporter data that are well-powered (larger sample, more occasions) to differentiate whether we are confronted with a Type 2 error or less robust findings.

The Current Study

This study evaluated the question of whether adolescent's school day challenges — defined as having difficulties with

teachers, difficulties with peers, and general difficulties during the school day — were associated with subsequent diminished family functioning. Using a three-week daily diary study, we applied multilevel modeling to evaluate within-day associations among adolescents' school day challenges and mothers' perceptions of the day's family functioning. We were able to disentangle within- and between-family associations to examine both within-family variations and sample-level trends across a broader spectrum of family functioning domains than previously studied. At the between-family level, we hypothesized that adolescents who experienced more school challenges during the study period would be more likely to live in families with lower cohesion, poorer mother–adolescent relations, and poorer interparental relations. At the within-family level, we hypothesized that on days when adolescents experienced more challenges than usual at school, mothers would report poorer family, mother–adolescent, and interparental relations than usual.

We also sought to evaluate gender differences in the within-day models of school day challenges and family functioning. Given the small number of fathers that participated in the study, we limited our sample to those families with participating caregivers that were mothers (95% of the sample). Mothers are often the primary caregivers during adolescence, spending considerable time on tasks related to daily care, parenting, and discipline, as well as being involved and knowledgeable of adolescent relationships and experiences outside the family context (Keijsers et al. 2010; Phares et al. 2009; Updegraff et al. 2001). Moreover, by only including mothers in our analyses, we improved the specificity of our moderation models. Theory on gender processes in the family indicate that mothers and daughters have closer relationships than mothers and sons (Shanahan et al. 2007; Updegraff et al. 2001), suggesting that findings will be stronger for adolescent girls' transmission of school day challenges into family relations (Chaplin and Aldao 2013). Interestingly, prior studies that tested gender moderation in daily school-family links have not been fruitful (Chung et al. 2011; Flook and Fuligni 2008; Lehman and Repetti 2007; Repetti 1996; Timmons and Margolin 2015). Thus, in this study, we treated tests of gender as a moderator as exploratory.

Method

Data for the current study come from the Penn State Family Life Optimizing Well-being (FLOW) study, a daily diary study wherein parents and their adolescents completed up to 21 daily reports about family functioning, their mood, and well-being.

Participants

In total, participants included 151 families of 9th and 10th grade adolescents recruited primarily through high schools in Pennsylvania, then from participant referrals. Due to the inclusion of participant referrals in the recruitment process, some families are from other geographic regions. Eligibility requirements included the following criteria: (1) two-caregiver family status, (2) adolescents lived in one household continuously, (3) internet access and means to complete daily surveys at home, (4) English fluency, (5) the participating adolescent was in 9th or 10th grade, and (6) both parent and adolescent consented/assented to participate.

A subset of the full sample was used for analysis, and non-school days were omitted from analysis. First, to examine interparental relations, the sample was limited to families indicating the primary and secondary caregivers were in a romantic relationship ($n = 147$). Second, given the small number of participating fathers ($n = 7$), the analytic sample was restricted to participating caregivers identifying as mothers or maternal figures ($n = 140$). Third, as analyses examine daily challenges experienced within the school context, the analytic sample was restricted to families with adolescents who attended traditional school settings and provided data on school day challenges ($n = 130$). The final sample included 130 participating families.

Participating adolescents — 76 females, 54 males — were between the ages of 14 and 16 years old ($M_{Age} = 14.75$, $SD_{Age} = 0.73$) and primarily identified as White (89.2%). Participating caregivers were between 30 and 61 years old ($M_{Age} = 43.74$, $SD_{Age} = 6.59$), primarily White (92.3%), and identified as their adolescent's mother (96.9%), step-mother (1.5%), aunt (0.8%), or foster mother (0.8%). Caregivers reported being married ($n = 121$) or living with a significant other ($n = 9$). Participating caregivers reported living together for an average of 17.9 years ($SD = 6.69$). Most participating caregivers completed at least a high school degree or something similar (96.9%), and over half had completed at least junior college or an associate's degree (65.4%). Based on eligibility criteria from the 2016–17 school year, 26.4% of the study sample was eligible for free or reduce price lunch. To compare relative rates, during the 2016–2017 school year, the free or reduced price lunch rates for the two high schools with the largest representation in our sample were 40.5 and 50.7% (PA Department of Education 2017). The family income for participants ranged from 'Less than \$10,000' to '\$125,000 and over' ($Median_{Income} = \$70,000 - \$79,999$).

Procedure

Families were recruited primarily through emails sent to parents from school principals. Other families were

recruited through referrals from study participants. Interested parents accessed study information through a web page containing detailed information about the purpose and design of the study and provided consent to participate and contact information. Consent forms and contact information was reviewed by research staff to determine eligibility of interested families. Once this determination was met, adolescents were contacted with a description of the study and an opportunity to assent or decline participation. If the adolescent assented, she/he was sent a link to a baseline survey, once completed, parents were emailed a link to complete their own baseline survey.

Upon completion of both baseline surveys, participants initiated the 21-day daily diary protocol. Links to daily surveys were emailed separately to parents and adolescents at 7:00 PM each evening, followed by a reminder text message or phone call. Parents and adolescents were instructed to complete their daily survey before going to bed, although access links remained open until 9:00 AM the next morning. In cases where participants completed surveys the following morning, they were instructed to report on the prior day. Thus, although parents and adolescents were sent surveys at the same time, adolescents were asked to answer questions specifically about the school day (which occurred earlier in the day) and parents answered questions about the days' family relations.

Daily surveys took approximately 5 min to complete each evening and included items related to family-level relationships (e.g., cohesion), parent–child relationship quality (e.g., conflict, warmth), interparental relations and parenting practices (parent-report only), daily emotion regulation, daily mood, and daily well-being. For the entire 21-day daily protocol, families provided daily reports on between 10 and 21 days ($M_{Parent} = 20.27$ (96.52%), $SD_{Parent} = 1.28$; $M_{Adolescent} = 19.00$ (90.48%), $SD_{Adolescent} = 2.52$). Because this study focused on adolescents' school challenges, data for analysis was restricted to days adolescents reported attending school. Adolescents were asked each day if they attended school, if they indicated yes, they were then asked to respond to questions about their school day experiences. Adolescent compliance rates were based on the number of total possible school days each participant could have attended, which ranged between 9 and 15 days during the 21-day daily diary protocol. Variability in the number of total possible school days relates to differences in each participants' academic calendar, as well as when, in the calendar year, they began the 21-day daily diary protocol. Adolescents in this sample provided daily school day reports on between 6 and 15 school days ($M_{Adolescent} = 11.50$ [85.11%], $SD_{Adolescent} = 2.26$) during the 21-day diary protocol. Parents provided family relations reports on 98.37% ($M_{Parent} = 11.33$, $SD_{Parent} = 2.32$) of days adolescents indicated attending school. At the conclusion of the

data collection protocol, parents and adolescents were compensated with Amazon or Walmart gift cards (based on preference): \$25 each after completing the baseline assessment; \$2.50 for the first 4 daily surveys of each week, and \$5 for the last 3 surveys of each week. For this portion of the study, families could be compensated up to \$200.

Measures

Our empirical analysis uses adolescents' daily reports about *school day challenges* and mothers' daily reports of *family cohesion*, *mother–adolescent closeness*, *mother–adolescent conflict*, *parenting behaviors*, *interparental positivity*, and *interparental conflict*. For scales with multiple items, we evaluated whether there was reliable within-person variability across days (R_c ; Bolger and Laurenceau 2013) and between-person reliability in measurement, accounting for repeated measures (R_{1F} ; Cranford et al. 2006). Although conventions for reliability estimates of daily diary measures are not yet established, generally R_c and R_{1F} values at or exceeding 0.5 are regarded as sufficient (Fosco and Lydon-Staley 2017; Geldhof et al. 2014; Iida et al. 2008; Ng and Lucianetti 2016).

Descriptions of how to calculate R_c , $R_c = \left(\frac{\sigma_{TP}^2}{\sigma_{TP}^2 + [\sigma_{TP}^2 + \sigma_v^2] / \kappa} \right)$, can be found in Bolger and Laurenceau (2013) and

$$R_{1F}, R_{1F} = \left(\frac{\sigma_{PERSON}^2 + \left[\frac{\sigma_{PERSON+ITEM/m}^2}{\sigma_{PERSON+ITEM/m}^2 + \sigma_{ERROR/m}^2} \right]}{\sigma_{PERSON}^2 + \left[\frac{\sigma_{PERSON+ITEM/m}^2}{\sigma_{PERSON+ITEM/m}^2 + \sigma_{ERROR/m}^2} \right] + \left[\frac{\sigma_{ERROR/m}^2}{\sigma_{PERSON+ITEM/m}^2 + \sigma_{ERROR/m}^2} \right]} \right), \text{ is found in}$$

Cranford et al. (2006). Adolescent gender was coded as a dichotomous variable (female = 0 and male = 1) to better facilitate interpretation of results.

School Day Challenges

On school days, adolescents rated that day's challenges at school, using a slider scaled 0 ("Very Bad") to 10 ("Very Good") in 0.1 increments. Adolescents responded to three items, "How was your day at school today", "How well did you get along with your teachers today", and "How well did you get along with your friends today". Daily *school day challenge* scores, calculated for adolescents (3 items) as the average of items, was reverse coded so larger numeric responses indicated more challenges at school. Daily *school day challenge* scores ranged from 0 to 10 ($M = 1.33$, $SD = 1.26$) for adolescents. Daily *school day challenges* demonstrated meaningful within-person ($R_c = 0.67$) and between-person ($R_{1F} = 0.82$) variation.

Family Cohesion

As part of each evening's web-based survey, mothers rated that day's level of family cohesion, adapted from the short version of the Family Environment Scale to fit a daily

timescale (Bloom 1985), using a slider scaled 0 ("Not at All") to 10 ("A lot") in 0.1 increments. Mothers responded to three items, "Family members really helped and supported one another", "There was a feeling of togetherness in our family", and "Family members really backed each other up". Daily *family cohesion* scores, calculated for mothers (3 items) as the average of items, ranged from 0 to 10 ($M = 7.69$, $SD = 1.77$). Daily *family cohesion* demonstrated meaningful within-family ($R_c = 0.82$) and between-family ($R_{1F} = 0.89$) variation. Validity for this scale is found in correlations with the Bloom (1985) scale in prior work (Fosco and Lydon-Staley in press).

Mother–Adolescent Connectedness

Mothers rated that day's level of mother–adolescent connectedness, using a slider scaled 0 ("Not at All") to 10 ("Very") in 0.1 increments. Mothers responded to four items, "I tried to understand my child's point of view", "I felt close and connected to my child", "I was loving and affectionate with my child", and "I felt loved by my child today". Daily *mother–adolescent connectedness* scores, calculated for mothers (4 items) as the average of items, ranged from 0 to 10 ($M = 7.99$, $SD = 1.65$). Daily *mother–adolescent connectedness* demonstrated meaningful within-family ($R_c = 0.80$) and between-family ($R_{1F} = 0.90$) variation. Individual averages of similar measures of daily connectedness are correlated with established between-person measures (Coffey et al. in press).

Mother–Adolescent Conflict

Mothers rated that day's level of mother–adolescent conflict, using a slider scaled 0 ("Not at All") to 10 ("Very") in 0.1 increments. Mothers responded to two items, "I was angry at my child", and "There was tension between my child and I today". Daily *mother–adolescent conflict* scores, calculated for mothers (2 items) as the average of items, ranged from 0 to 10 ($M = 0.97$, $SD = 1.12$). Daily *mother–adolescent conflict* demonstrated meaningful within-family ($R_c = 0.74$) and between-family ($R_{1F} = 0.60$) variation.

Parenting Practices

Mothers rated that day's parenting practices, using a slider scaled 0 ("Not at All True") to 10 ("Very True") in 0.1 increments. Mothers responded to six items, including, "I praised or complimented my child for good behavior", "I enforced parenting rules and/or expectations with my child", "My disciplinary decisions depended on my mood", and "I felt like a good parent today". Daily *parenting practice* scores, calculated for mothers (5 items) as the

average of items, ranged from 0 to 10 ($M = 7.92$, $SD = 1.44$). Daily *parenting practices* demonstrated meaningful within-family ($R_c = 0.56$) and between-family ($R_{1F} = 0.78$) variation. These items were developed to reflect positive parenting practices (Fosco and LoBraico 2019).

Interparental Positivity

Mothers each rated that day's level of positivity/warmth between caregivers, using a slider scaled 0 ("Not at All") to 10 ("A Lot") in 0.1 increments. Mothers responded to two items, "My partner and I GOT ALONG with each other today", and "My partner was LOVING and AFFECTIONATE with me today." Daily *interparental positivity* scores, calculated for mothers (2 items) as the average of items, ranged from 0 to 10 ($M = 7.58$, $SD = 2.18$). Daily *interparental positivity* demonstrated meaningful within-family ($R_c = 0.72$) and between-family ($R_{1F} = 0.86$) variation.

Interparental Conflict

Participating mothers each rated that day's level of conflict with secondary caregivers, using a slider scaled 0 ("Not at All") to 10 ("A Lot") in 0.1 increments. Mothers responded to two items, "My partner and I were MAD AT EACH OTHER today" and "My partner and I DISAGREED WITH EACH OTHER today". Daily *interparental conflict* scores, calculated for mothers (3 items) as the average of items, ranged from 0 to 10 ($M = 0.99$, $SD = 1.11$). Daily *interparental conflict* demonstrated meaningful within-family ($R_c = 0.82$) and between-family ($R_{1F} = 0.65$) variation. These items were adapted to be similar to prior work (Cummings et al. 2003). Prior work with this sample has found this measure of interparental conflict to correspond to variation in adolescent daily mood and well-being (Fosco and Lydon-Staley 2019).

Data Analysis Plan

Multilevel modeling captures the nested nature of daily reports of family and school experiences within individuals (Bolger and Laurenceau 2013). The multilevel modeling analytic approach allows links between school and home contexts to be examined at both the within- and between-person levels. Within- and between-family equations were estimated in the nlme package (Pinheiro et al. 2017) using the RStudio statistical program (RStudio Team 2016). All models were run using RStudio version 1.0.136 (RStudio Team 2016).

Before conducting multilevel models, data preparation and preliminary analyses were conducted. First, the within- and

between-family effects were disentangled by splitting each family variable into two separate variables using group-mean-centering (Bolger and Laurenceau 2013). Second, means, standard deviations, and ranges were calculated for each variable. Third, unconditional means models were conducted to test the amount of within-person variance available to be modeled, ensuring sufficient within-person variance to proceed with multilevel models. Fourth, potential differences in adolescents' same-day versus next-day responses were analyzed. Finally, average within- and between-family correlations were calculated to determine potential multicollinearity and domain specificity across family domain variables.

Then, multilevel models were computed in two steps. In the first step, the Level 1 equation estimated the within-family effect of adolescents' reports of day's school challenges predicting variability in mothers' reports of family functioning.

Level 1:

$$\begin{aligned} \text{InterparentalPositivity}_{it} = & \beta_{0i} + \beta_{1i}\text{Day'sSchoolChallenges}_{it} \\ & + \beta_{2i}\text{Time}_{it} + e_{it} \end{aligned} \quad (1)$$

The Level 2 equation accounted for between-family differences in usual school challenges and daily family functioning.

Level 2:

$$\begin{aligned} \beta_{0i} = & \gamma_{00} + \gamma_{01}\text{UsualSchoolChallenges}_i + \gamma_{02}\text{YGender}_i \\ & + \gamma_{03}\text{YAge}_i + u_{0i} \\ \beta_{1i} = & \gamma_{10} + u_{1i} \\ \beta_{2i} = & \gamma_{20} \end{aligned} \quad (2)$$

In the second step, adolescent gender was included in the models to estimate whether gender moderates the within-person association between adolescents' reports of day's school challenges and mothers' reports of daily family functioning.

Level 2:

$$\begin{aligned} \beta_{0i} = & \gamma_{00} + \gamma_{01}\text{UsualSchoolChallenges}_i + \gamma_{02}\text{YGender}_i \\ & + \gamma_{03}\text{YAge}_i + u_{0i} \\ \beta_{1i} = & \gamma_{10} + \gamma_{11}\text{YGender}_i + u_{1i} \\ \beta_{2i} = & \gamma_{20} \end{aligned} \quad (3)$$

Bonferroni correction was employed when evaluating significance levels of each model in the first and second steps of analysis. To calculate the corrected p-value, the original α -value (0.05) was divided by the number of family relations in each domain (family-level relations: $p < 0.05$; mother-adolescent relations: $p < 0.017$; interparental

Table 1 Descriptive statistics for adolescent and mother daily variables

	<i>M</i>	<i>SD</i>	Range	Occasions	ICC	<i>R_c</i>	<i>R_{IF}</i>
Adolescent Daily Report							
School Challenges ^{a,b}	1.33	1.26	0.00 to 10.00	1484	0.40	0.67	0.82
Mother Daily Report							
Family Cohesion ^{a,b}	7.69	1.77	0.00 to 10.00	1445	0.40	0.82	0.89
Mother–Adolescent Closeness ^{a,b}	7.99	1.65	0.00 to 10.00	1461	0.34	0.80	0.90
Mother–Adolescent Conflict ^{a,b}	0.97	1.12	0.00 to 10.00	1459	0.71	0.74	0.60
Parenting Practices ^{a,b}	7.92	1.44	0.00 to 10.00	1461	0.36	0.56	0.78
Interparental Positivity ^{a,b}	7.58	2.18	0.00 to 10.00	1461	0.35	0.72	0.86
Interparental Conflict ^{a,b}	0.99	1.11	0.00 to 10.00	1460	0.74	0.82	0.65

N = 130 participants

^aWithin-day scale of averaged daily items

^bAveraged across individual reporters

Table 2 Between-person bivariate correlations for study variables

	1	2	3	4	5	6	7	8	9
School Challenges	–								
Family Cohesion	–0.26**	–							
Mother–Adolescent Closeness	–0.24**	0.84**	–						
Mother–Adolescent Conflict	0.26**	–0.39**	–0.45**	–					
Parenting Practices	–0.28**	0.81**	0.86**	–0.41**	–				
Interparental Positivity	–0.39**	0.76**	0.66**	–0.28**	0.74**	–			
Interparental Conflict	0.28**	–0.35**	–0.30**	0.43**	–0.40**	–0.53**	–		
Adolescent Gender	–0.05	–0.11	–0.19*	0.20*	–0.15	–0.05	0.10	–	
Adolescent Age	0.03	–0.04	–0.08	0.01	–0.12	–0.10	0.15	0.03	–

N = 130 participants

Gender is dichotomous with 0 = female and 1 = male

***p* < 0.01, **p* < 0.05, +*p* = 0.05

relations: *p* < 0.025). These are noted at the bottom of the table presenting the multilevel model results.

Results

Table 1 presents the mean, standard deviation, and range for each variable, as well as interclass correlations representing the proportion of within-person variance present, total number of occasions, and estimates of within-person (*R_c*) and between-person (*R_{IF}*) reliability for each measure. The low base rates of school challenges, mother–adolescent conflict, and interparental conflict seen in this study are common and comparable to past work (ex. Bai et al. 2016; Weymouth et al. 2016; Fosco and LoBraico 2018; Timmon and Margolin 2015); however, all had sufficient within-person reliability for analysis. Preliminary analyses indicated that 5% of adolescent school day responses were submitted the morning after surveys were distributed; there

were no meaningful differences in analyses for responses submitted on the same-day versus the next morning.

Table 2 presents a summary of the between-person bivariate correlations for variables included in analyses. As expected, mothers' reports of family relations within each domain were moderately to highly correlated. Indicators of positive family relations were moderate to highly correlated across family functioning domains (e.g., family-level, mother–adolescent, interparental), suggesting that family relation domains are inter-related (Fosco and LoBraico 2018). Adolescent daily reports of challenges at school were moderately associated with mother perceptions of family relations across domains (*r* = –0.39 to 0.28) in the expected directions. Adolescents who experienced more challenges at school had families with lower levels of family cohesion (*r* = –0.26), mother–adolescent closeness (*r* = –0.24), positive parenting (*r* = –0.28), and interparental positivity (*r* = –0.39). School challenges were positively correlated with mother–adolescent (*r* = 0.26) and interparental conflict (*r* = 0.28).

Table 3 Day's and average adolescent school challenges predicting family processes

	Family-Level	Mother–Adolescent			Interparental	
	1 Cohesion	2 Closeness	3 Conflict	4 Parenting	5 Positivity	6 Conflict
Fixed Effects	Estimate (SE)	Estimate (SE)	Estimate (SE)	Estimate (SE)	Estimate (SE)	Estimate (SE)
Intercept (γ_{00})	7.86* (0.19)	8.27* (0.17)	0.77* (0.12)	8.08* (0.15)	7.70* (0.22)	0.83* (0.12)
Usual SC (γ_{01})	−0.43* (0.12)	−0.39* (0.11)	0.20* (0.07)	−0.38* (0.09)	−0.75* (0.14)	0.14 (0.08)
Day's SC (γ_{10})	−0.07 (0.06)	−0.14* (0.04)	0.13* (0.05)	−0.12* (0.04)	−0.16* (0.06)	0.08 (0.06)
Gender (γ_{02})	−0.40 (0.3)	−0.68* (0.28)	0.47* (0.19)	−0.40 (0.24)	−0.22 (0.36)	0.38 (0.19)
Youth Age (γ_{03})	−0.19 (0.18)	−0.21 (0.16)	0.06 (0.11)	−0.22 (0.14)	−0.15 (0.21)	0.15 (0.11)
Time (γ_{20})	−0.01 (0.01)	−0.01* (0.01)	−0.02* (0.01)	−0.01 (0.00)	−0.01 (0.01)	−0.02* (0.01)
Day's SC*Gender (γ_{11})	−0.22* (0.10)	–	–	–	–	–
Bonferroni Correction	* $p < 0.05$	* $p < 0.017$			* $p < 0.025$	
Random Effects	Estimate [CI ₉₅]	Estimate [CI ₉₅]	Estimate [CI ₉₅]	Estimate [CI ₉₅]	Estimate [CI ₉₅]	Estimate [CI ₉₅]
Level 2 (between-person)						
Intercept (u_{0i})	2.65 [2.04, 3.45]	2.26 [1.74, 2.93]	0.95 [0.73, 1.25]	1.70 [1.14, 2.20]	3.71 [2.85, 4.81]	0.96 [0.68, 1.35]
Day's SC (u_{1i})	0.03 [0.01, 0.16]	0.03 [0.01, 0.09]	0.04 [0.01, 0.14]	0.04 [0.01, 0.09]	0.07 [0.03, 0.17]	0.08 [0.03, 0.20]
Level 1 (within-person)						
Residual	1.91 [1.76, 2.06]	1.33 [1.23, 1.44]	2.39 [2.22, 2.59]	1.07 [0.99, 1.16]	2.32 [2.14, 2.51]	2.66 [2.46, 2.88]
Autocorrelation	−0.01 [−0.07, 0.05]	0.01 [−0.05, 0.07]	−0.07 [−0.13, −0.01]	0.03 [−0.03, 0.09]	0.00 [−0.07, 0.08]	−0.02 [−0.08, 0.05]

$N = 130$. SC = School challenges. Time refers to days in the sequence of assessments. Gender is dichotomous with 0 = female and 1 = male. Asterisks reflect significant effects for each domain using Bonferroni correction. [CI₉₅] refers to the upper and lower bounds for confidence intervals for the random effect variances, except in cases of autocorrelation

Multilevel Models Evaluating Within- and Between-Family Effects of School Challenges on Family Relations

Multilevel models are presented in Table 3. The first model evaluated findings for family-level cohesion (column 1). Daily variation in adolescents' school challenges were not associated with daily variation in family cohesion. However, at a between-family level, adolescents who experienced more school challenges lived in families rated lower in cohesion by mothers ($\gamma_{01} = -0.43$, $p < 0.05$).

Three models were estimated in the mother–adolescent relations domain, including those predicting mother–adolescent closeness (column 2), mother–adolescent conflict (column 3), and mothers' parenting practices (column 4). In all three models, within-family effects emerged for adolescents' school day challenges. Specifically, on days when adolescents experienced more challenges at school than usual, mothers reported increases in mother–adolescent conflict ($\gamma_{10} = 0.13$, $p < 0.017$), as well as decreases in mother–adolescent closeness ($\gamma_{10} = -0.14$, $p < 0.017$) and positive parenting practices ($\gamma_{10} = -0.12$, $p < 0.017$) when compared to usual levels. Between-family results were found across all three models. Adolescents who experienced more challenges at school tended to have worse mother–adolescent relations. Specifically, adolescents who had more challenges at school were in families where mothers reported lower levels of mother–adolescent closeness ($\gamma_{01} = -0.39$, $p < 0.017$), higher levels of mother–adolescent conflict ($\gamma_{01} = 0.20$, $p < 0.017$), and less positive parenting ($\gamma_{01} = -0.38$, $p < 0.017$), on average.

The last two models predicted interparental positivity (column 5) and conflict (column 6). Within family findings emerged for interparental positivity, but not for conflict. On days when adolescents experienced more challenges at school than usual, mothers reported decreases in interparental positivity ($\gamma_{10} = -0.16$, $p < 0.025$). These results were mirrored at the between-family level in which school challenges were correlated with interparental positivity ($\gamma_{01} = -0.75$, $p < 0.025$) but not with interparental conflict.

The bottom half of Table 1 presents the random effects for each model. The confidence intervals for the intercepts and slopes, across all models, indicated statistically significant variability in both. Finally, significant first-order autocorrelation of residuals was only found in the mother–adolescent conflict model.

Post hoc analyses were conducted to determine if within-person associations between adolescents' school day challenges and mothers' subsequent reports of family relations were affected by baseline levels of adolescent depressive symptoms, measured by the Revised Child Anxiety and Depression Scale (Ebesutani et al. 2012). Across all models, no moderation was found.

Testing Adolescent Gender as a Moderator of the Association between Adolescent School Challenges and Mother Perceptions of Family Relations

Multilevel models were then re-computed with the addition of gender as a cross-level moderator of within-family associations among school challenges and family relations.

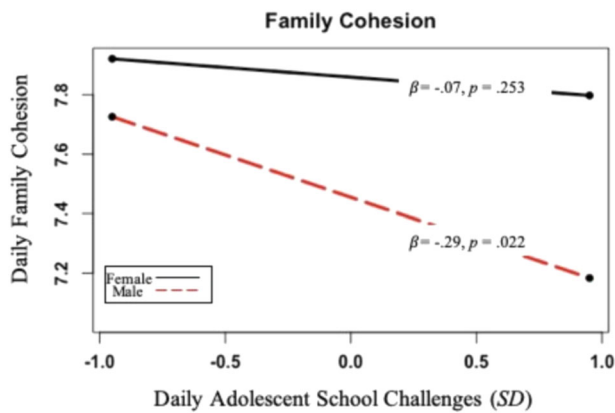


Fig. 1 Moderation effect of adolescent gender on same day association between school challenges and mother report of family cohesion

Interaction terms are presented in Table 3. Across six models, a statistically significant finding emerged for adolescent gender moderation when predicting family cohesion. The within-day association between school challenges and family relations were significant for males, but not females (see Fig. 1). Specifically, on days when males experienced more school challenges than usual, mothers reported decreased family cohesion ($b = -0.22$, $p = 0.027$).

Discussion

The goal of this study was to examine how adolescents' challenges at school were linked to family-level, mother–adolescent, and interparental domains of family functioning. Using daily diary data collected during 9th or 10th grade from mother–adolescent dyads, this study examined how daily variations in adolescent school challenges predicted their mothers' perceptions of family relations on the same day. Strengths of this study include (a) cross-reporter methods in which adolescents reported on their school day experiences and mothers reported on daily family relations, (b) evaluating a broader range of family outcomes than prior studies, and (c) leveraging a design that benefitted from statistical power to resolve inconsistent findings among prior studies addressing related questions. Using multilevel models, it was possible to disentangle within- and between-family effects. Between-family effects revealed that higher levels of school challenges were associated with poorer family relations, per mother reports. Statistically significant within-family results indicated that on days when adolescents experienced more challenges at school than usual, mothers also reported poorer family relations across domains. Thus, although school challenges may be low-base rate occurrences, they appear meaningful for daily variation in family functioning.

Our between-family level hypothesis were supported. Specifically, adolescents who experienced more challenges at school had lower (mother-reported) levels of family cohesion, mother–adolescent closeness, parenting practices, and interparental positivity; adolescents who experienced more challenges at school also had higher levels of mother–adolescent conflict. Mothers spend considerable time with adolescents, frequently communicating with them about their daily lives and activities, as well as providing social support and guidance (Elam et al. 2017; Keijsers et al. 2010; Milkie et al. 2015). This pattern of results may suggest that adolescents experiencing higher levels of school day challenges may also experience lower levels of social support from their mothers. Similar to research examining the family stress model, adolescents' extra-familial stressors are associated with subsequent parent reports of lower quality parent-child relations and parenting practices (Masarik and Conger 2017). Within the context of parental extrafamilial stressors, lower quality family relations and parenting practices have been linked to adolescent internalizing and externalizing behaviors (Masarik and Conger 2017). More research is needed to understand the role of adolescents' school day stressors when combined with other extrafamilial family stressors already associated with poorer adolescent outcomes.

Within the interparental relations domain, finding suggest that adolescents who experienced more challenges at school tended to have mothers who reported lower levels of positive interpersonal relations, but conflict between parents was not significantly correlated. Previous research has generally focused on the deleterious effects of interparental conflict on adolescent developmental outcomes (Buehler et al. 1997; Krishnakumar and Buehler 2000), but work on interparental warmth suggests that low levels of positive interparental interactions may also be a risk factor for instability in the couple relationship (Bradbury and Karney 2004). Further, in the absence of interparental conflict, marital disharmony has been associated with lower levels of child prosocial behaviors across contexts (McCoy et al. 2009). Although adolescents' school day challenges were not significantly correlated with higher levels of interparental conflict, tensions within interparental relations associated with lower levels of interparental positivity may negatively impact the broader family emotional climate, which has been negatively linked to adolescent internalizing (Luebbe and Bell 2014).

By examining within-family effects, we effectively used families as their own comparisons, evaluating how day-to-day changes in adolescents' school day challenges correspond to variations in family relations across days; thus, within-family analyses circumvent common third-variable concerns that plague between-family studies (Bolger and Laurenceau 2013). Moreover, across all analyses, within-family findings

did not differ for adolescents with higher or low levels of depressive symptoms. Study findings partially support of our within-family hypothesis. On days when adolescents experience more school challenges than usual, mothers reported more mother–adolescent conflict, and diminished mother–adolescent closeness, parenting and interparental positivity. Our findings replicate prior research that documents links between adolescent school day challenges and conflict at home, and extends existing literature to other domains of parenting and interparental relations (Chung et al. 2011; Flook and Fuligni 2008; Timmons and Margolin 2015). Consistent with prior work, daily school challenges did not covary with daily interparental conflict (Timmons and Margolin 2015); however, on days when adolescents experienced more school challenges than usual, their mothers reported less warmth and affection with their partners. This pattern of results, implicating daily school challenges for interparental warmth, but not conflict, may be indicative of the relatively high-functioning nature of this sample. Perhaps in other samples, characterized by greater levels of family distress, other findings would emerge. Additionally, there may be other ecological factors to be considered. Work-related stress has been linked to lower quality interparental relations and high rates of interparental conflict (Story and Repetti 2006). Little is known about the role of adolescent-specific extrafamilial stressor on empirical findings associated with parent-specific stressors on family functioning. Our findings underscore how adolescent-specific extrafamilial stressors may contribute the quality of family relations that are ultimately associated with their own development (Serbin et al. 2015).

An additional finding emerged when testing cross-level gender moderation of the within-family effects. Although there was no main effect of school day challenges, gender moderation revealed that, on days when boys experienced more school challenges than usual, their mothers reported diminished family cohesion; this finding did not hold for girls. This finding runs contrary to previous research pointing to school challenges as particularly salient for mother–daughter relationships (Almeida and Kessler 1998; Shanahan et al. 2007). Instead, girls were equally likely as boys to transmit school day challenges into parenting practices and interparental relations, and boys were more likely than girls when considering family cohesion. It is possible that, consistent with presumed gender socialization practices in which girls are penalized for expressions of anger or externalizing behaviors, they may convey sadness or anxiety in the family, eliciting different changes in the family than boys (Davies and Lindsay 2004). Socialization practices for adolescent males may emphasize externalizing behaviors as a means of coping with frustrations or challenges (Davies and Lindsay 2001; Grych et al. 2003), and this may lead boys to be more disruptive to the broader family context (Marceau et al. 2015) similar to the current findings for family cohesion.

Implications for Translation

Much of the previous research on family stress and family functioning has focused on parents as agents of change and sole producers of extrafamilial stress. Yet, this study provides consistent, robust evidence linking adolescent's school day stressors to mother reports of poorer family relations across domains. Moreover, these findings support the need to include adolescent-specific stressors in family stress models examining how extrafamilial stressors are associated with subsequent family relations (Masarik and Conger 2017); little is known about how adolescent-specific stressors may inflate or exacerbate the effects of parent-specific work or economic stressors on family functioning. Moreover, these findings highlight associations between adolescents reporting higher levels of school day challenges having mothers who subsequently report experiencing poorer quality family relations. Adolescents' experiences of school day challenges may serve as an indicator of poor social support or coping strategies in students not displaying other, more obvious indicators of distress. These findings support the practice of identifying and providing support for adolescents and adolescent-specific stressors that may be associated with whole-family functioning. Most of the support and resources available to families with adolescents are only accessible when academic, psychological, or behavior problems have been identified. Providing more general support is consistent with a recent meta-analysis of family-based prevention programs, where including child-focused content often bolsters overall program effects (Van Ryzin et al. 2016). Including adolescent-specific content into family-based prevention programs will provide families skills to better neutralize the potential impact of school challenges in family relations, and practical strategies to help adolescents cope with extrafamilial stressors. The current study suggests that family researchers should consider how adolescent experiences outside the family context are linked to important family relations.

Limitations and Future Directions

The current study has several important limitations to consider. Although the analyses include both adolescent and mother report in the same household, analyses were limited to maternal perceptions of family relations and their relationship with their partner. A study strength is reflected in the disentangling of effects by using both adolescent and mother reports, but the sample of caregivers was homogenous. The inclusion of fathers would have provided nuanced information into potential caregiver gender differences related to perceptions of family relations across domains. Moreover, future studies should include fathers to examine how potential father vulnerabilities (Goeke-Morey

and Cummings 2007) and paternal involvement in key family relations are associated with adolescent-driven effects. Second, the current sample broadly lacked diversity in regard to the participating families. Increased diversity across socioeconomic status, racial/ethnic backgrounds, and adolescent risk indicators would provide insights into how links between key family relations and school day challenges may differ. The final limitation relates to a lack of temporal ordering regarding our data collection methods. We believe that our temporal assumptions are upheld, as adolescents were asked to retrospectively report of school challenges, and mothers reports of family relations were collected in the evening; however, because adolescents and mothers received surveys at the same time each evening, it is possible that other factors impact the study results. Future studies using multiple assessments during the day would provide a more precise test of the temporal ordering of our findings.

Conclusion

Results from the current study have important implications for family researchers and practitioners. Congruent with previous research, this study demonstrates that more difficult days at school are associated with maternal perceptions of diminished warmth across family functioning domains. Moreover, the current study extends the research literature by detailing the scope and reach of adolescent school day challenges links to important mother-specific domains such as parenting and interparental positivity. In conclusion, this research emphasizes the necessity of understanding how adolescent daily experiences are linked to key family relations relevant to adolescent development and well-being, as well as broader functioning throughout the family context.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the Pennsylvania State University IRB and with the 1964 Helsinki declaration and its later amendments.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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