Intergenerational Transmission of Multiple Problem Behaviors: Prospective Relationships between Mothers and Daughters

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Abstract Much of the research examining intergenerational continuity of problems from mother to offspring has focused on homotypic continuity (e.g., depression), despite the fact that different types of mental health problems tend to cluster in both adults and children. It remains unclear whether mothers with multiple mental health problems compared to mothers with fewer or no problems are more likely to have daughters with multiple mental health problems during middle childhood (ages 7 to 11). Six waves of maternal and child data from the Pittsburgh Girls Study ($n=2,451$) were used to examine the specificity of effects of maternal psychopathology on child adjustment. Child multiple mental health problems comprised disruptive behavior, ADHD symptoms, depressed mood, anxiety symptoms and somatic complaints, while maternal multiple mental health problems consisted of depression, prior conduct problems and somatic complaints. Generalized Estimating Equations (GEE) was used to examine the prospective relationships between mother's single and multiple mental health problems and their daughter's single and multiple mental health problems across the elementary school-aged period (ages 7–11 years). The results show that multiple mental health problems in the mothers predicted multiple mental health problems in the daughters even when earlier mental health problem of the daughters, demographic factors, and childrearing practices were con-
trolled. Maternal low parental warmth and harsh punishment independently contributed to the prediction of multiple mental health problems in their daughter, but mediation analyses showed that the contribution of parenting behaviors to the explanation of girls' mental health problems was small.

Keywords Multiple problem behaviors in mothers · Multiple problem behaviors in daughters · Disruptive behavior · Depressed mood · Parenting

There is a substantial literature demonstrating that multiple mental health problems are common in adults. Approximately 50% of adults with a mental health problem have more than one other concurrent diagnosable disorder (Clark et al. 1995; Moffitt et al. 2001). In particular, depression in women typically co-occurs with other disorders (Kessler et al. 1994). There is also an extensive literature on co-occurring multiple mental health problems in children and adolescents (Bardone et al. 1996; Capaldi and Stoolmiller 1999; Fergusson et al. 1994; Kovacs et al. 1988; Loeber et al. 1998; Mesman et al. 2001; Oldehinkel et al. 2004; Thomas and Guskin 2001), as well as the successive development of externalizing and internalizing problems (e.g., Boylan et al. 2007; Burke et al. 2005). Multiple, compared to single, mental health problems are associated with functional impairment, a more chronic course of disorder and poor treatment outcome (e.g., Verhulst and van der Ende 1993). A meta-analysis by Angold et al. (1999) reported that a median Odds Ratio for two disorders in youth ranged from approximately *3.0* (Attention Deficit Hyperactivity Disorder (ADHD) + anxiety; Conduct Disorder (CD) + anxiety) to *10.7* (CD/Oppositional Defiant Disorder + ADHD). Many of the studies on co-occurring problems, however, had small N's and focused on select samples (e.g., Kovacs et al. 1988; Tiet et al. 2001), and

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there is little known about the development of multiple mental health problems in general population samples. Moreover, most of the studies on co-occurring problems have focused on adolescent samples (e.g., Elliott et al. 1989; Jessor and Jessor 1977) and few have reported on multiple mental health problems in preadolescent samples (e.g., Fergusson et al. 1994; Gilliom and Shaw 2004). In particular, there is a scarcity of studies that focus on the development of multi-problem girls at a young age (Boylan et al. 2007).

It has been long known that there is an early-onset group of boys whose multiple mental health problems, such as noncompliant and aggressive behaviors, are manifest in childhood (Farrington et al. 1990; Loeber and Farrington 2001). Some scholars discounted the possibility that there are early-onset cases for girls (e.g., Silverthorn and Frick 1999), but there is increasing evidence that such cases exist (e.g., Brennan et al. 2003; Crick et al. 2006; McCabe et al. 2004; White and Piquero 2004).

Available studies only occasionally indicate that certain patterns of multiple mental health problems are more common in one gender than the other. Under certain circumstances, girls have an elevated risk of psychopathology and comorbid disorders compared to boys (Boyle and Pickles 1997; Davies and Windle 1997). This has been articulated in the gender paradox, showing that the gender in which the disorder is rare, compared to the gender in which the disorder is more common, is at higher risk of displaying comorbid disorders (Loeber and Keenan 1994). For example, although ADHD is rare in girls, girls who qualify for ADHD compared to boys with ADHD have a much higher likelihood of developing CD (Szatmari et al. 1989). Also, even though CD is rarer in girls than in boys, CD in girls is associated with a higher risk of these girls developing personality disorder in adulthood (Cohen 1996). Some researchers have suggested that the familial continuity of certain forms of psychopathology is perhaps more distinct in girls than in boys. For instance, girls may be more vulnerable than boys to the effects of maternal depression (Hops 1996). Importantly, Cloninger et al. (1975) documented that sociopathy is more common in men than in women, but it is more prevalent among relatives of sociopathic women than among relatives of sociopathic men. Along that line, we would expect the gender paradox to be transmitted along the female line of the offspring of affected women. The current study explores this hypothesis by focusing on the associations between multiple mental health problems in biological mothers and their daughters.

Much has been published on the continuity of homotypic disorders and maladjustment across generations. A large body of evidence has documented the heightened vulnerability of offspring of parents for certain forms maladjustment. Several studies have shown that antisocial and delinquent behavior often occurs across successive generations (Faraone et al.

1991a, b; Farrington et al. 2001; Lahey et al. 1988; Stewart et al. 1980) and that this also applies to depression (Beardslee et al. 1983; Cummigs and Davies 1994; Downey and Coyne 1990; Goodman and Gotlib 1999; Hammen et al. 1987; Rutter 1990; Weissman et al. 1997).

A variety of mechanisms have been postulated as being responsible for intergenerational continuity of depression (Garber and Flynn 2001) such as genetic predisposition (Todd et al. 1993), emotional unavailability of the caregiver (Simons et al. 2002), and impairments in parenting and dysfunctional family relationships (e.g. Cummigs and Davies 1994; Downey and Coyne 1990; Fergusson et al. 1994; Garber and Flynn 2001; Olsson et al. 1999; Rutter 2000). Yet the risks for children are known to extend beyond depression (Downey and Coyne 1990; Goodman and Gotlib 1999; Kurtjens and Wolke 2001; Luoma et al. 2001) and include a range of other types of psychopathology, most commonly, disruptive behavior disorders (Radke-Yarrow et al. 1992; Weissman et al. 1997). In fact, point prevalence rates of psychiatric disorders among children of depressed parents have been estimated to be 2–5 times above normal (Beardslee et al. 1993, 1998; Weissman et al. 1986).

However, heterotypic continuity of psychopathology is also known across generations, such as the consistently reported relationship between parental substance abuse, and antisocial behavior and somatization problems in the daughters (Bohman et al. 1984; Cadoret 1978). There is also a substantial body of research showing that maternal depression and perceived stress are related to disruptive behaviors in offspring (Dumas and Wahler 1985; Ghodsian et al. 1984; Loeber et al. 1998; Zahn-Waxler et al. 1990). Since much of this research has concerned male offspring samples, research examining such influences on the development of conduct problems in school-aged and adolescent girls is required. Further specification is needed to identify which forms of familial psychopathology pose the greatest risk to girls, and to test the mechanisms of action.

It is important to also consider maternal childrearing practices to fully understand how childrearing practices mediate the association between mother's multiple problems and multiple problems in their girls. For example, earlier studies have shown that depressed mothers often display impaired childrearing practices (Goodman and Gotlib 1999), and that this is also true for mothers who had childhood conduct problems, or who had been convicted (Farrington et al. 1975, 2001; Loeber and Stouthamer-Loeber 1986). For each type of psychopathology, the mothers may have less patience with their child and display harsh punishment and inconsistent discipline in response to aggression (e.g., Conger et al. 2003; Thornberry et al. 2003).

The key aim of the paper is to examine the correspondence and continuity between mothers' and daughters' mental health problems at different ages and to investigate

the extent to which multiple problems in the mother are related to multiple problems of the daughters during middle childhood even when parenting is taken into account. The paper addresses the following questions by making use of longitudinal data from the Pittsburgh Girls Study:

1. Which combinations of girl's mental health problems are most common between ages 7 and 11?
2. Is there homotypic correspondence between mother's mental health problems and the mental health problems of their daughter during middle childhood?
3. Are multiple mental health problems in mothers related to multiple mental health problems in their daughters, and is the association between mothers' problems and those of their daughters stable over time?
4. Is the development of multiple mental health problems in girls during middle childhood predicted by multiple mental health problems of the mother?
5. Do parenting practices explain away the association between mother's multiple mental health problems and the multiple mental health problems of their daughter or do parenting practices have unique explanatory power? And does parenting mediate the association between mothers' and daughters' multiple mental health problems?

Methods

Sample Description

The participants of the Pittsburgh Girls Study (PGS) are 2,451 five to eight-year old girls recruited from a sample of 103,238 households in the City of Pittsburgh. Participants were identified by a stratified, random sampling of households in Pittsburgh neighborhoods where households in low-income neighborhoods were over-sampled. For the purposes of this study, neighborhoods were deemed low-income if at least 25% of the families were living at or below the poverty level, using 1990 Census data on poverty. Enumeration was completed in 89 of the 90 City of Pittsburgh neighborhoods during 1999, when households in low-income neighborhoods were fully enumerated (i.e., all households were contacted to determine eligibility for the study) while half of the households in other neighborhoods were randomly sampled. In total, 3,241 girls were in the 5- to 8-year old age range. Of those girls initially identified as meeting the age criterion, 2,876 were asked to take part in the longitudinal study. From this pool, a total of 2,451 (85.2%) girls and their parent agreed to participate (for further details, see Hipwell et al. 2002).

At the time of the first interview, the sample comprised 588 five-year olds (cohort 5), 630 six-year olds (cohort 6),

611 seven-year olds (cohort 7), and 622 eight-year olds (cohort 8). All parents completed the interview during the first year. High rates of parent retention have been achieved across 6 years of follow-up (97.2%, 95.2%, 94.0%, 92.9%, and 92.2% in Years 2 to 6 respectively). Similarly, high rates of child retention have been achieved (97.0%, 94.7%, 93.6%, 92.5%, and 91.9% in Years 2 to 6 respectively). Teacher retention has also remained quite high (77.8%, 87.7%, 84.8%, 83.8%, 80.9%, and 82.5% in Years 1 to 6 respectively). Because we used a best estimate calculation (see below), the more limited availability of teacher ratings compared to parent ratings did not reduce the available N for the study.

African Americans girls made up slightly more than half of the sample (53.0%), while 41.2% of parents reported that the girl was Caucasian. Most of the remaining 5.8% girls were described as multi-racial. Nearly all caregivers (83.2%) had at least a high school education. In a majority of households (58.7%), the caregiver was cohabiting with a spouse or domestic partner in Year 1. Also in the first year of assessment, 38.9% families reported receiving public assistance in the form of WIC, food stamps, or welfare. In 92.7% of the interviews, the primary caregiver was a biological parent and in 92.9% of the cases the caregiver interviewed was female. Of the caregivers, 86.1% were the biological mother, and data from these caregivers only ($N=$ 2111) were used in the current analyses.

Data Collection

Human subject review and appropriate parental consent and child assent were obtained. Separate in-home interviews for both the child and the parent were conducted annually by trained interviewers using a laptop computer. Parents gave further feedback by completing and returning a booklet comprised of additional self-report questionnaires. Teacher participation was obtained using questionnaire booklets, distributed via a mix of mail and hand-delivery. All participants were reimbursed for their involvement.

Sample Selection

This paper uses data drawn from the first six annual assessment waves of the PGS to cover a developmental period of 7–11 years (Fig. 1). To be included in the analyses, 80% of the analytic constructs needed to be available for each subject both within each year as well as across the 7–11 year period. And finally, of those cases, all of the parent report needed to be from the biological mother. As a consequence of the multiple cohort design, N's varied by age: 1446 for age 7, 1932 for ages 8 to 10, and 1459 for age 11, with a final sample size of $N=1932$.

Fig. 1 Design and sequence of Pittsburg Girls Study assessment (n=2,451)

Cohort	Age (years)												
	5	6	7	8	9	10	11	12	13	14	15	16	17
5 (n=588)	PT	PT	CPT	CPT	CPT	CPT	CPT	CPT	CPT	CPT			
6 (n=630)		PT	CPT	CPT	CPT	CPT	CPT	CPT	CPT	CPT	CPT		
7 (n=611)			CPT	CPT	CPT	CPT	CPT	CPT	CPT	CPT	CPT	CPT	
8 (n=622)				CPT	CPT	CPT	CPT	CPT	CPT	CPT	CPT	CPT	CPT

▨ Completed assessments (2000-2007)

▨ Data used in the current analyses – ages 7-11 years

Note: C = Child; P = Parent; T = Teacher

Measures

Child Mental Health Problems

Disruptive Behavior Items assessing the nature and severity of disruptive behavior disorder symptoms using criteria from the Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition (DSM-IV), included CD and Oppositional Defiant Disorder (ODD) and were obtained primarily from the *Child Symptom Inventory-4* (*CSI-4*, Gadow and Sprafkin 1994). Each symptom was scored on 4-point (0–3) scale of *never*, *sometimes*, *a lot*, and *all the time*. Both the parent and teacher CSI-4 included the same 8 ODD items. The parent version of the CSI-4 includes 13 CD items in years 1–3 and all 15 CD items in years 4–6 (truancy, and running away were not assessed until year 4). Teachers were administered 8 CD items in years 1–3 and 9 items in years 4–6 (truancy was not assessed until year 4). Six remaining DSM-IV CD symptoms (e.g., forced sexual activity, stays out at night) were not assessed by the teacher due to the teacher's inability to appropriately assess such items. Furthermore, all but two CD behaviors were assessed on the teacher CSI-4. Physical fights and destruction of property were assessed on the teacher version of the *Self Reported Antisocial Scale* (SRA, Loeber et al. 1998) for ages 7–10 and the *SRD* (Loeber et al. 1998) for age 11. The SRA items were assessed on 3-point scales (0–2: *never, once/twice, more often*) and the SRD items were assessed on 4-point scales (0–3: *never, 1-2 times, 3-5 times, 6 or more*). These SRA and SRD items were standardized to match the CSI scaling. For these analyses, the higher score for each item of the parent or teacher report was used. All items were summed to create a total score ranging from 0 to 63 with high internal consistency (α=0.87). The sum of the ODD and CD items was then dichotomized according to established cut-scores of at least 'moderate' to 'high' severity.

Depression A construct of child self-reported depressive symptoms was created from the 13 items of the *Recent Moods & Feelings Questionnaire* (MFQ, Angold et al. 1995) reflecting depressed mood over the past two weeks. For example, girls were asked "In the past two weeks is it true for you that you cried a lot?" Items were scored on 3-point scales (0–2: *not true, sometimes true, true*) and summed to create a total score ranging from 0 to 26. The construct showed good reliability (α=0.83). Dichotomizing based on the published cut score yielded a widely varying prevalence (13.3%–36.1%) in the data across years; therefore, the score was conservatively dichotomized based on 13% or higher to remain consistent across years.

Somatization The 18 item short-version of the *Children's Somatization Inventory* (SOM, Walker et al. 1991; Garber et al. 1991) was used to measure children's somatic complaints via parent. Parents were asked to rate the extent to which their daughter had suffered from somatic symptoms (e.g., headaches, pains in lower back, heart beating too fast) during the past two weeks. Responses were scored on 5-point scales (0–4) ranging from '*not at all*' to '*a whole lot*' and summed to create a total score ranging from 0 to 72 (α=0.79). There is no established cut-score for this measure. In order to achieve an extreme score we dichotomized the measure on a cut-score of 5 or higher (the published median score of a well sample was 3).

ADHD symptoms The nature and severity of symptoms of ADHD were measured using 9 inattention items, 6 hyperactivity items, and 3 impulsivity items from the *Child Symptom Inventory-4* (*CSI-4*, Gadow and Sprafkin 1994). As for CD and ODD, each symptom was scored on 4-point (0–3) scales of *never*, *sometimes*, *a lot*, and *all the time*. Parent and teacher were both administered the same 18-items. For these analyses, the higher score for each item of the parent

or teacher report was used. All items were summed to create a total score ranging from 0 to 54 (α=0.90). The score was then dichotomized based on the original scale's cut-score of 'high' severity according to the CSI manual.

Anxiety Symptoms Children's anxiety symptoms were assessed utilizing the 41 items from the *Screen for Child Anxiety and Related Emotional Disorders* (SCARED, Birmaher et al. 1997, 1999) as reported by parents. Sample items include 'she is nervous,' 'she doesn't like to be with people she doesn't know well,' and 'she gets scared if she sleeps away from home.' Items were scored on 3-point scales (0–2: *not true or hardly ever true, sometimes true, very true*). All items were summed to create a total score ranging from 0 to 82 (α=0.89). The score was then dichotomized based on the original scale's clinical cut-score.

Number of Child Problems Each dichotomized score was then summed to create a count of total number of child mental health problem behaviors endorsed for each age between ages 7–11. This count variable ranged from 0 to 5.

Maternal Mental Health Problems

Depression The *Beck Depression Inventory-II* (BDI-II, Beck et al. 1996) was used to measure maternal self-reported depressed mood over the past two weeks. The 21 items (e.g., guilty feelings, pessimism, and sadness) were scored on 4-point scales (0–3) ranging from '*absent*' to '*severe*', and were summed to create a total score ranging from 0 to 63 (α=0.90). The score was then dichotomized based on the original scale's cut-score denoting 'moderate' to 'high' severity.

Conduct Problems The *Structured Clinical Interview for DSM-III-R, Conduct Disorder* (SCID-CD, First et al. 1996) was used to assess the biological mother's report of conduct problems occurring prior to age 15. Mothers responded either '*yes*' or '*no*' to 15 items such as 'did you bully or threaten other kids' and 'did you start fights.' The SCID-CD was administered once in year 3. All items were summed to create a total score ranging from 0 to 15 with good internal consistency (α=0.79). The CD scores were dichotomized based on the presence of three (or more) of the required criteria for a DSM-IV diagnosis of CD.

Somatization Maternal somatic symptom severity was measured using the *Patient Health Questionnaire-15* (PHQ-15). The 15-items measure the level of somatic complaint (e.g., stomach pain, back pain, chest pain) over the past 4 weeks using a 3-point scale (0–2: *not bothered at all, bothered a little, and bothered a lot)*. The PHQ-15 was

administered in each year starting in year 3. All items were summed to create a total score ranging from 0 to 30 (α=0.82). The score was then dichotomized based on the original scale's cut-score of 'medium' to 'high' severity.

Number of Maternal Problems The three dichotomous items (depression, conduct problems and somatization) were then summed to create a count of total number of maternal mental health problems endorsed, ranging from 0 to 3. Because the PHQ was only collected starting in year 3, the count variable of maternal mental health problems was only calculated for girls of ages 9–11 years, with maternal conduct problems used as a time-invariant variable.

Measures of Parenting

Harsh Punishment Harsh punishment was assessed using 6-items from the *Conflict Tactics Scale—Parent/Child* (CTSPC, Straus et al. 1998). Mothers responded on 3-point scales (1–3) of '*never*,' '*sometimes*,' or '*often*' to items asking for example, 'In the past year, if your daughter did something that she is not allowed to do or something that you didn't like, how often did you shout, yell, or scream at her?' All items were summed to create a total score ranging from 6 to 18 (α=0.69).

Low Maternal Warmth Six-items of the *Parent-Child Relationship Scale* (PCRS, Loeber et al. 1998) were used to assess low warmth from the mother. Mothers responded to items such as 'How often have you felt like you needed a vacation from her' and 'How often have you felt she was a troublemaker' on 3-point scales (1–3: *almost never, sometimes, and often*). All items were summed to create a total score ranging from 6 to 18 (α=0.71).

Inconsistent Discipline was assessed using 4-items of the *Discipline Scale* (Loeber et al. 1998). Mothers were asked to respond *almost never, sometimes, or almost always* (0–2) to items such as 'If a punishment has been decided upon, can your daughter change it by explanations, arguments, or excuses?' All items were summed to create a total score ranging from 0 to 8 (α=0.63).

Data Analyses

Because we over-sampled girls from the most disadvantaged neighborhoods, all analyses are adjusted for this over-sampling by utilizing a weighting variable making results representative of the population of 5–8 year old girls in the City of Pittsburgh (Hipwell et al. 2002).

In Year 6, only 64 participants (2.6%) were considered to be permanently lost from the study. Three of these 64
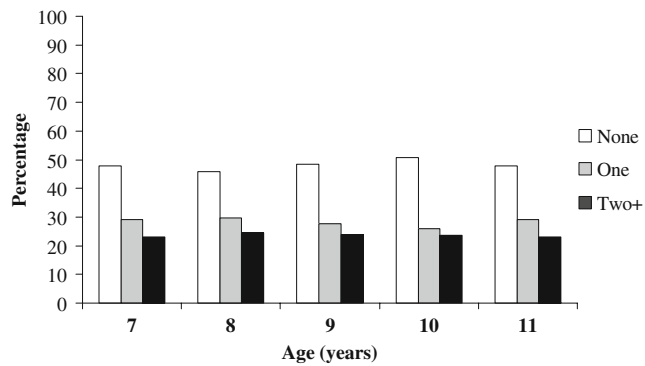
Fig. 2 Number of child multiple problem behaviors by age

subjects, however, did meet criteria to be included in these analyses, so the remaining 61 girls were compared with those retained ($N=1932$) on the key variables of interest from year 1. The families who dropped out were mostly Caucasian ($\chi^2=8.57$, $df = 1$, $p=0.003$), not receiving public assistance ($\chi^2 = 5.48$, $df = 1$, $p=0.019$), and more likely to have completed 12 years of formal education ($\chi^2 = 5.37$, $df = 1$, $p=0.021$). In terms of child problems, the retained sample reported more somatization ($F = 4.52$, $df = 1993$, $p=0.034$) and had more ADHD symptoms ($F = 9.67$, $df = 1993$, $p=0.002$). Finally, mothers of girls retained for these analyses reported more harsh punishment ($F = 28.49$, $df = 1992$, $p<0.001$) and less parental warmth ($F = 7.44$, $df = 1988$, $p=0.006$). In summary, families who dropped out appeared to have fewer risk characteristics.

The co-occurrence of all combinations of the dichotomized child mental health problems (i.e., disruptive behavior, depression, somatization, ADHD, and anxiety) was examined using conditional Odds Ratios obtained from a series of separate logistic regression analyses.

Generalized Estimating Equations (GEE, Liang and Zeger 1986) was used to estimate the overall relationship between variables over time and allow for the fact that, because the data have been collected on the same individuals on successive occasions, the repeated observations are expected to be correlated over time. GEE allows this correlation to be taken into account in order to obtain valid standard errors of the parameter estimates. GEE models also enables the correlation structure of the data (i.e., without assuming that measurements taken at successive points in time are equally correlated or that they have an unstructured pattern of correlations) to be modeled.

In the current analyses, GEE was used to predict levels of the dependent variable at time t + 1, after accounting for levels at time t, to produce an aggregate parameter estimate over time and thus utilizing a Transitional Marginal Model (Fitzmaurice et al. 2004). In the current analyses, an independent correlation structure was employed. This correlation structure approximates the results of an ordinary least squares regression while ignoring the lack of independence among the observations. This can result in a more efficient analysis, with improved power to detect significant changes over time. Race, cohort, and maternal education were included as time-invariant covariates. Single parenthood and public assistance were included as time-varying covariates.

Results

In order to address the first question, we first examined whether the proportion of multi-problem girls changed with age between 7–11 years. Figure 2 shows that between 26% and 30% of the girls had a single problem, which remained the same for the age interval studied while between 23% and 25% had two or more problems, which also was similar across ages 7 to 11. Table 1 shows that the strength of most associations between different problems remained similar between ages 7 and 11. The likelihood of co-occurring disruptive problems among girls with somatic problems ranged from 1.4 to 1.7. The only temporal trend in Odds Ratios appeared to be between ADHD and co-occurring

Table 1 Co-occurrence of Child Problem Behaviors (Odds Ratio)

Behaviors	7		8		9		10		11	
	OR	CI	OR	CI	OR	CI	OR	CI	OR	CI
ADHD symptoms + disruptive behavior	9.1	6.7–12.3	11.5	8.9–15.0	10.4	7.9–13.6	12.0	9.0–15.8	14.2	10.3–19.6
Anxiety symptoms + disruptive behavior	1.8	1.3–2.5	1.9	1.5–2.5	1.4	1.1–1.9	1.4	1.0–1.9	1.9	1.3–2.6
Depressed mood + disruptive behavior	2.1	1.5–3.0	2.4	1.8–3.2	2.2	1.7–3.0	2.4	1.8–3.2	2.4	1.7–3.4
Somatic complaints + disruptive behavior	1.4	1.1–2.0	1.5	1.2–1.9	1.4	1.1–1.9	1.7	1.3–2.3	1.7	1.3–2.2
ADHD symptoms + depressed mood	1.8	1.2–2.5	2.4	1.8–3.2	2.3	1.7–3.0	3.2	2.3–4.3	2.0	1.4–2.9
Anxiety symptoms + depressed mood	1.0	0.6–1.5	1.7	1.2–2.3	1.6	1.2–2.2	1.3	0.9–1.9	2.1	1.4–3.1
Somatic complaints + depressed mood	1.2	0.8–1.8	1.7	1.3–2.3	1.8	1.4–2.4	1.6	1.2–2.2	1.4	1.0–1.9

OR Odds Ratio; *CI* 95% confidence intervals

Table 2 Zero-order Correlations between Maternal Multiple Problem Behaviors (0–3) and Multiple Child Problem Behaviors Index (0–5)

| Mother's multiple problem behaviors	Daughter's multiple problem behaviors		
	9	10	11
9	0.31**	0.29**	
10		0.30**	0.29**
11			0.32**

*p ≤ 0.05; **p ≤ 0.01

disruptive behavior symptoms, which ranged from 9.1 at age 7, to 14.2 at age 11. This increase, however, was not statistically significant.

The next question concerns the extent to which mother's multiple mental health problems co-occurred with and predicted their daughters' multiple mental health problems. Table 2 shows the correlation between maternal multiple mental health problems (ranging from 0–3) and the multiple mental health problems index for their daughter (ranging from 0–5) between ages 9 and 11. The diagonal in the table shows the zero-order correlations, which are quite stable and range from 0.31 to 0.32 (across three waves). Predictive correlations were of the same magnitude: mother's multiple mental health problems predicted their daughter's multiple mental health problems in the next year

for ages 9 to 10, and for ages 10 to 11 (r's = 0.29). Thus, there was a modestly strong concurrent and predictive association between the multiple mental health problems of the mother and the multiple mental health problems of their daughter during middle childhood.

Next, we tested homotypic co-occurrence across generations, starting with whether maternal depression co-occurred with the daughter's depressed mood. Figure 3 shows that at ages 7 through 8 there was no significant homotypic association between mother's and daughter's depressed mood, but at ages 9 to 11, the two correlated significantly. For example, at age 11, one in four daughters (25.2%) of a depressed mother scored high on depression, compared to only 12.3% of daughters of nondepressed mothers. The homotypic intergenerational association for conduct problems was more consistent than for depression. Figure 3 shows that the association between mother's and daughter's conduct problems was significant at all ages between ages 7 and 11. For example, at age 11 twice as many girls had conduct problems when their mother also had had conduct problems when young, compared to girls of mothers without conduct problems (32.2% vs. 16.7%). Turning to homotypic continuity of somatic problems, between ages 9 and 11, there was a significant association between maternal somatic problems and daughter's somatic problems. Figure 3 shows that at age 11 almost 2½ times as many daughters of mothers with

* p<.05, ** p<.01, *** p<.001
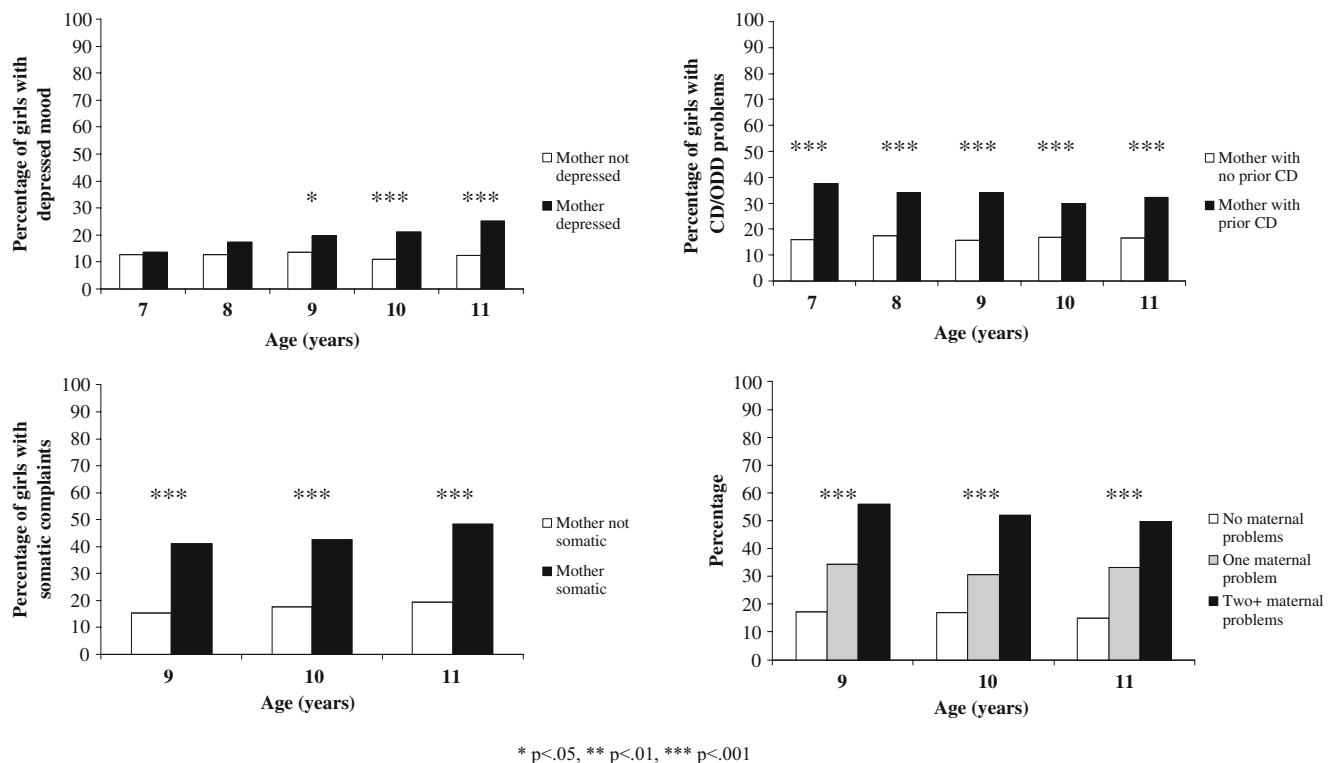
Fig. 3 Congruence between maternal and child problems

somatic problems also showed somatic problems compared to daughters of mothers without somatic problems (48.2% vs. 19.4%).

To what extent did multiple mental health problems in the mothers coincide with multiple mental health problems in the girls? The right lower chart in Fig. 3 shows that there was a step-wise increase between no maternal problems, one maternal problem, and two or more maternal problems in the percentage of girls with two or more child mental health problems for each age between 9 and 11. For example, at age 9, 17.2% of the mothers without a problem had a daughter with multiple mental health problems (i.e., two or more problems), compared to 34.2% of mothers with a single problem and more than half of mothers (55.9%) with two or more problems.

We next examined, using GEE, whether maternal depression predicted the daughter's multiple mental health problems during middle childhood. We first entered the covariates (Table 3), of which child multiple mental health problems (at time t) (IRR = 1.56; $p<0.001$), minority race (IRR = 1.06; $p=0.039$), public assistance (at t) (IRR = 1.11; $p<0.001$), and single parenthood (at t) (IRR = 1.12; $p<0.001$) predicted child multiple mental health problems at t + 1. Adding maternal depression to the equation did not alter the significant covariates but showed that maternal depression (at t) also significantly predicted their daughter's multiple mental health problems in the following year (IRR = 1.20; $p<0.001$). We next entered prior maternal conduct problems (at t), which was significant (IRR = 1.18; $p<0.001$), with most prior significant factors remaining significant (the

Table 3 Predicting Daughter's Multiple Problem Behaviors (t + 1) Across Ages 7–11 with and without Including Parenting

Covariates only	IRR	SE	z	p	95% CI for IRR	IRR	SE	z	p	95% CI for IRR
Daughter's multiple problem behaviors (t)	1.56	0.02	41.43	<0.001	1.53–1.59	1.46	0.02	31.29	<0.001	1.43–1.50
Minority race	1.06	0.03	2.07	0.039	1.00–1.13	1.07	0.03	2.21	0.027	1.01–1.14
Cohort	1.02	0.01	1.77	0.076	1.00–1.05	1.02	0.01	1.66	0.096	1.00–1.04
Public assistance (t)	1.11	0.03	3.91	<0.001	1.06–1.18	1.10	0.03	3.41	0.001	1.04–1.16
Single parenthood (t)	1.12	0.03	4.06	<0.001	1.06–1.18	1.11	0.03	3.62	<0.001	1.05–1.17
Low maternal education	1.03	0.03	1.26	0.207	0.98–1.09	1.02	0.03	0.57	0.570	0.96–1.07
Low maternal warmth (t)						1.08	0.01	11.57	<0.001	1.06–1.09
Harsh punishment (t)						1.02	0.01	2.83	0.005	1.01–1.03
Inconsistent discipline (t)						1.01	0.01	0.86	0.391	0.99–1.02
Adding mother's depression to model										
Child multiple problem behaviors (t)	1.54	0.02	39.58	<0.001	1.51–1.57	1.45	0.02	30.61	<0.001	1.42–1.49
Minority race	1.07	0.03	2.17	0.030	1.01–1.13	1.07	0.03	2.31	0.021	1.01–1.14
Cohort	1.02	0.01	1.67	0.095	1.00–1.04	1.02	0.01	1.61	0.107	1.00–1.04
Public assistance (t)	1.10	0.03	3.45	0.001	1.04–1.16	1.09	0.03	3.13	0.002	1.03–1.15
Single parenthood (t)	1.12	0.03	3.97	<0.001	1.06–1.18	1.11	0.03	3.57	<0.001	1.05–1.17
Low maternal education	1.03	0.03	1.01	0.312	0.98–1.08	1.01	0.03	0.46	0.649	0.96–1.07
Low maternal warmth (t)						1.07	0.01	11.37	<0.001	1.06–1.09
Harsh punishment (t)						1.02	0.01	2.62	0.009	1.00–1.03
Inconsistent discipline (t)						1.00	0.01	0.63	0.530	0.99–1.02
Mother's depression (t)	1.20	0.04	5.20	<0.001	1.12–1.28	1.12	0.04	3.27	0.001	1.05–1.20
Adding mother's conduct problems to model										
Daughter's multiple problem behaviors (t)	1.53	0.02	37.85	<0.001	1.49–1.56	1.45	0.02	29.89	<0.001	1.41–1.48
Minority race	1.05	0.03	1.64	0.102	0.99–1.11	1.06	0.03	1.92	0.055	1.00–1.13
Cohort	1.02	0.01	1.71	0.088	1.00–1.04	1.02	0.01	1.64	0.102	1.00–1.04
Public assistance (t)	1.08	0.03	2.75	0.006	1.02–1.14	1.08	0.03	2.58	0.010	1.02–1.14
Single parenthood (t)	1.11	0.03	3.72	<0.001	1.05–1.17	1.10	0.03	3.42	0.001	1.04–1.16
Low maternal education	1.01	0.03	0.48	0.628	0.96–1.07	1.00	0.03	0.11	0.916	0.95–1.06
Low maternal warmth (t)						1.07	0.01	11.09	<0.001	1.06–1.09
Harsh punishment (t)						1.02	0.01	2.24	0.025	1.00–1.03
Inconsistent discipline (t)						1.00	0.01	0.57	0.568	0.99–1.02
Mother's depression (t)	1.19	0.04	4.82	<0.001	1.11–1.27	1.12	0.04	3.14	0.002	1.04–1.20
Mother's conduct problems (t)	1.18	0.03	6.24	<0.001	1.12–1.25	1.14	0.03	4.64	<0.001	1.08–1.20

exception was minority race). Thus, mother's depressed mood and conduct problems earlier in life significantly predicted their daughter's multiple mental health problems between ages 7 to 11 even when controlling for the child's earlier multiple mental health problems and several demographic factors.

Separate analyses were run for mother's somatization problems because their measurement became available at a later point than depressed mood. When maternal somatization problems were introduced in the model (Table 4), the results showed that mother's somatization (at t) significantly contributed (IRR = 1.17; $p<0.001$) to the prediction of their daughter's multiple mental health problems at ages 9–11 even when mother's depressed mood, conduct problems, earlier child multiple mental health problems and demographic factors were taken into account.

The results suggest that multiple mental health problems of the mothers contributed to the prediction of their daughter's multiple mental health problems at a young age. To investigate this further, we used the 0–3 count of mother's multiple mental health problems (composed of depressed mood, conduct problems, and somatization problems). Table 4 (bottom left panel) shows that this index of mother's multiple mental

health problems (at t) significantly contributed (IRR = 1.18; $p<0.001$) to the prediction of child's multiple mental health problems at t + 1 (ages 9 to 11) even when earlier child multiple mental health problems and demographic factors were taken into account.

The next question concerned whether mothers' multiple mental health problems predicted daughters' multiple mental health problems during middle childhood even when maternal childrearing practices were taken into account. The right segment of Table 3 shows that low maternal warmth (at t) (IRR = 1.08; $p<0.001$) and harsh punishment (at t) (IRR = 1.02; $p=0.005$), but not inconsistent discipline (at t) predicted child multiple mental health problems at t + 1 between ages 7 and 11 even when time t multiple child problems and the demographic factors were taken into account. The middle right segment of that table shows that low maternal warmth (at t) (IRR = 1.06; $p<0.001$) and harsh punishment (at t) (IRR = 1.02; $p=0.001$) remained significant when maternal depression (at t) (IRR = 1.12; $p=0.001$) was introduced into the equation. The bottom right segment of Table 3 shows that when mothers' conduct problems are added, in addition to depression, mothers' conduct problems contributed (at t)

Table 4 Predicting Daughter's Multiple Problem Behaviors (t + 1) Across Ages 9–11 with and without Including Parenting

Adding maternal somatization to model	IRR	SE	z	p	95% CI for IRR	IRR	SE	Z	p	95% CI for IRR
Daughter's multiple problem behaviors (t)	1.51	0.02	27.86	<0.001	1.47–1.56	1.44	0.02	22.48	<0.001	1.39–1.48
Minority race	1.08	0.04	2.08	0.038	1.00–1.17	1.09	0.04	2.22	0.026	1.01–1.18
Cohort	1.06	0.02	3.53	<0.001	1.03–1.10	1.06	0.02	3.56	<0.001	1.03–1.10
Public assistance (t)	1.11	0.04	2.86	0.004	1.03–1.20	1.11	0.04	2.85	0.004	1.03–1.20
Single parenthood (t)	1.16	0.04	4.07	<0.001	1.08–1.25	1.15	0.04	3.78	<0.001	1.07–1.24
Low maternal education	1.00	0.04	0.10	0.918	0.94–1.07	0.99	0.04	−0.37	0.711	0.92–1.06
Low maternal warmth (t)						1.07	0.01	7.73	<0.001	1.05–1.09
Harsh punishment (t)						1.02	0.01	1.99	0.046	1.00–1.04
Inconsistent discipline (t)						1.01	0.01	0.64	0.532	0.99–1.03
Mother's depression (t)	1.17	0.06	3.32	0.001	1.07–1.29	1.11	0.05	2.20	0.028	1.01–1.21
Mother's conduct problems (t)	1.17	0.04	4.23	<0.001	1.09–1.25	1.12	0.04	2.99	0.003	1.04–1.20
Mother's somatization (t)	1.17	0.05	3.82	<0.001	1.08–1.28	1.15	0.05	3.46	0.001	1.06–1.25
Adding mother's multiple problem behaviors to model										
Daughter's multiple problem behaviors (t)	1.51	0.02	33.59	<0.001	1.47–1.54	1.43	0.02	26.90	<0.001	1.39–1.47
Minority race	1.07	0.03	2.21	0.027	1.01–1.14	1.09	0.04	2.50	0.012	1.02–1.16
Cohort	1.05	0.01	3.54	<0.001	1.02–1.07	1.04	0.01	3.29	0.001	1.02–1.07
Public assistance (t)	1.09	0.03	2.87	0.004	1.03–1.16	1.09	0.03	2.82	0.005	1.03–1.16
Single parenthood (t)	1.11	0.03	3.37	0.001	1.04–1.18	1.10	0.03	3.09	0.002	1.04–1.17
Low maternal education	1.01	0.03	0.42	0.674	0.96–1.07	1.00	0.03	−0.05	0.958	0.94–1.06
Low maternal warmth (t)						1.07	0.01	9.80	<0.001	1.06–1.09
Harsh punishment (t)						1.01	0.01	1.55	0.120	1.00–1.03
Inconsistent discipline (t)						1.00	0.01	0.53	0.598	0.99–1.02
Mother's multiple problem behaviors (t)	1.18	0.02	9.18	<0.001	1.14–1.22	1.14	0.02	7.14	<0.001	1.10–1.18

(IRR = 1.14; $p<0.001$) to the daughters' multiple problems with low maternal warmth (at t) (IRR = 1.06; $p<0.001$) and harsh punishment (at t) (IRR = 1.02; $p=0.002$) remaining in the equation. Thus, each of the mothers' problems—depression and earlier conduct problems—predicted the daughters' multiple problems even when childrearing practices were taken into account.

The upper right portion of Table 4 repeats the analyses but now for mothers' somatization problems, showing that low maternal warmth (at t) (IRR = 1.07; $p<0.001$) and harsh punishment (at t) (IRR = 1.02; $p=0.046$) still predicted multiple child problems at ages 9 to 11 even when the mothers' somatization problems (at t) (IRR = 1.15; $p=0.001$) (and all other demographic factors) were taken into account. In a final analysis, we examined whether mothers' mental health problems predicted the daughters' multiple mental health problems when earlier child multiple mental health problems, the demographic factors, and the mothers' childrearing practices were taken into account. The results show (see lower right portion of Table 4) that maternal multiple mental health problems (IRR = 1.14; $p<0.001$) significantly predicted child multiple mental health problems even when considering childrearing practices. In summary, the mothers' mental health problems predicted their daughters' multiple mental health problems in middle childhood, independent of the unique contributions of low maternal warmth and harsh punishment.

In the final set of analyses, we examined whether childrearing practices mediated the linkage between the mother's multiple mental health problems and their daughter's multiple mental health problems (Fig. 4). Two regression models were used to test for each statistical mediation. The first model determined whether there was a significant association between mother's multiple mental health problems and each parenting characteristic. The second regression model examined mother's multiple mental health problems and each individual parenting characteristics together predicting the daughter's multiple

problems. To be concise, the test statistic displayed at the bottom of Fig. 4 delineates the model with all three parenting characteristics included simultaneously. The test statistics for the models that considered each parenting characteristic individually was almost identical to this omnibus statistic. The Sobel test (MacKinnon et al. 2002; Sobel 1982) confirmed that inconsistent discipline ($p=0.06$) did not statistically mediate the relationship between mothers' and the daughters' multiple problems. On the other hand, low warmth ($p<0.001$) and harsh punishment ($p<0.001$) did partially statistically mediate the relationship between mother's multiple problems and the daughter's multiple problems. However, the degree of reduction in the overall strength of the relationship between mother's and their daughter's problems is so minimal as to be hard to discern. Therefore, the partial mediation from low warmth and harsh punishment appears to be statistically but not meaningfully significant, and mother's multiple problems and parenting (i.e., low warmth and harsh punishment) are mostly contributing uniquely to the daughter's multiple problems.

Discussion

To our knowledge this is the first study examining the development of multiple mental health problems in a population sample of girls during middle childhood as a function of their biological mother's mental health problems, childrearing practices, and demographic factors. The key findings are as follows. Between ages 7 to 11, disruptive behavior and ADHD symptoms were the most closely related problems, but significant associations were also found with other mental health problems. The proportion of girls with multiple mental health problems did not increase between ages 7 and 11. The association between mothers' depression and their daughters' depression was significant at ages 9–11, but not earlier. Thus, mothers' depression became associated with the daughters'
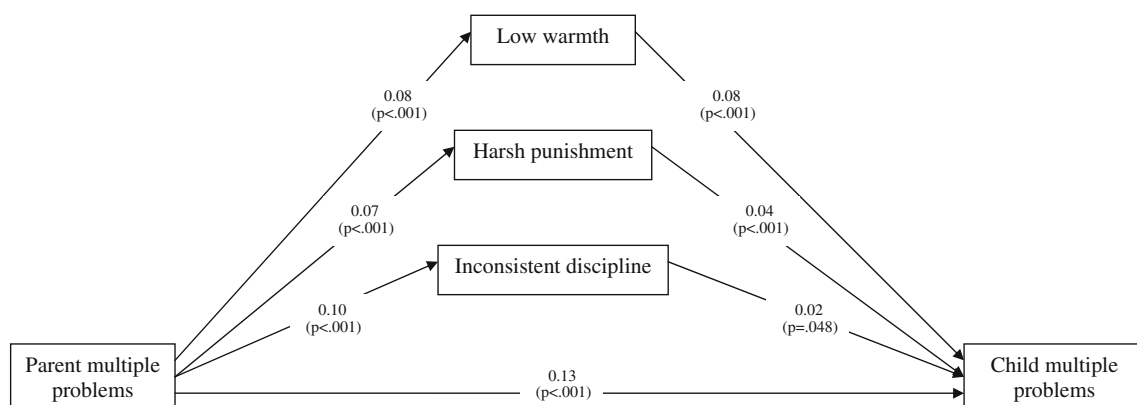
Fig. 4 Test of a mediation model for childrearing practices

depression prior to adolescence, which is the period in which depression in girls often emerges. The results also showed that prior mothers' conduct problems were associated with their daughters' disruptive mental health problems in middle childhood. Maternal somatic complaints were closely associated with child somatic complaints. Study findings also demonstrated that multiple mental health problems of the mothers were related to multiple mental health problems of the daughters. Over half of the girls (50–56%) with multiple mental health problems had mothers also reporting multiple mental health problems. Parenting practices somewhat mediated the association between mothers' mental health problems and the daughters' mental health problems, but the strength of the mediation effects was small, indicating that mothers' mental health problems were directly related to the daughters' mental health problems.

The findings have several implications for clinical work. Early detection and screening of the off-spring of mothers with multiple forms of psychopathology is still uncommon. We propose that such early screening is warranted, and would facilitate early identification and possible participation of young girls in interventions to prevent further development of psychopathology. However, we are not aware of the availability of evidence-based interventions for emerging multiple problems in girls at a young age, and this area of research has, in our opinion, high priority. It not clear whether an intervention aimed at reducing multiple problems in the mother will lead to a reduction of multiple problems of the daughter. Conversely, it would be important to see under which conditions interventions for multiple problem girls become effective even if the multiple mental health problems of the mothers persist.

The present research has several limitations. Criteria for the mental health problems in this research did not match clinical criteria, and this was especially true for the daughters who in middle childhood did not tend to display clinical depression and other forms of psychopathology. Much of the research on the intergenerational continuity of mental health problems has focused on mothers with a clinical history of depression (e.g., Beardslee et al. 1998), but it has been suggested that the extent of the mother's symptomatology has a greater impact on the child and the mother-child interaction than the presence or absence of a diagnosis (Hammen et al. 1987). The results of the current study indicate that the cumulative impact of mother's psychopathology, her characteristics (low education) and childrearing practices later increased the risk of multiple mental health problems in the offspring (see also Fergusson et al. 1994).

We could not examine the correspondence of mental health problem at the same developmental stage in mothers and their daughters. Instead, we examined mental health problem in mother's characteristic of their adult life stage

with mental health problem in their daughters' characteristic between ages 7 and 11. It remains to be seen to what extent the seeds of multiple mental health problems are laid in the preschool period. We also did not examine in this paper the development of consecutive comorbidity in the girls. For example, in adolescent females, depression typically emerges after the onset of Conduct Disorder (Loeber and Keenan 1994; Moffitt et al. 2001; Robins 1986; Zoccolillo 1992). We expect that as the girls enter adolescence, they will show increasing rates of conduct problem symptoms, substance use, and depressed mood.

The study did not directly assess reciprocal relationships between the mental health problems of mothers and daughters. A number of empirical reviews have documented the influences of maternal mood on child adjustment outcomes (e.g., Cummigs and Davies 1994; Downey and Coyne 1990; Goodman and Gotlib 1999; Lovejoy et al. 2000), but far fewer have included a balanced account of simultaneous influences of child behavior on maternal functioning (Elgar et al. 2004). For example, Elgar et al. (2003a, b) reported on a 4-year cross-lagged panel study of maternal depression and child adjustment problems (i.e., hyperactivity, aggression, and emotional problems) with the objective of examining their antecedent-consequence conditions. The results suggested that maternal depressive symptoms tended to coincide with or precede child emotional problems but also tended to change as a consequence of child aggression and hyperactivity. Analyses of our own data (Hipwell et al. 2002) have shown that girls' conduct problems and depressed mood are stronger predictors of negative parenting practices than vice versa between ages 7–12 years. Moreover, across this developmental period, some specificity of effects was found. Thus, girls' depressed mood predicted a reduction in maternal warmth, whereas conduct problems predicted increases in harsh punishment (firmer control, stronger limit-setting) when the effects of both conduct problems and depressed mood were examined together.

The current study did not clarify whether there were differences between maternal and paternal continuity of problems to their daughters. In the future we hope to rectify this now that we have obtained funding for the assessment of fathers, which with knowledge of the behavioral development of the male siblings will help us to address the possible intergenerational continuity of the gender paradox. It should be noted that GEE analyses that we used reflect a marginal model, i.e. the average person's change within the population, which constitutes a backdrop against which more homogeneous groups of girls with multiple mental health problems can be compared.

The continuity of mental health and adjustment problems is not limited to two generations but has been documented across three generations (e.g., Brook et al. 2003; Thornberry

et al. 2003) and is likely to continue across many more generations. In the Pittsburgh Girls Study, we plan to follow up the girls and their own off-spring. Eventually, this will enable us to examine more closely the early stages of emotional regulation and mental health problems between three generations of women. A major unanswered question is whether the relationship between multiple mental health problems across generations is a result of the continuity of underlying problems, such as temperament (Oldehinkel et al. 2004), emotional disregulation (e.g., Cole and Zahn-Waxler 1992), or some other underlying trait such as behavioral disinhibition (Young et al. 2000), that is genetically transmitted across generations (e.g., Young et al. 2000) or is the result of gene-environmental interactions (Taylor and Kim-Cohen 2007).

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