Offspring Personality Mediates the Association between Maternal Depression and Childhood Psychopathology

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Abstract

Offspring of mothers diagnosed with major depression are at increased risk for a wide range of psychological problems. Previous research has shown that individual differences in personality development can be informative for predicting risk and resilience to psychopathology, especially within at-risk populations. In the present study, we examined whether individual differences in offspring personality development during early to middle childhood could account for the association between maternal depression and offspring behavior problems later in childhood. Participants included 64 offspring of mothers diagnosed with major depression and 68 offspring of healthy comparison mothers. Personality was assessed via parent report at ages 3, 4, 5, and 9. Offspring internalizing and externalizing symptoms were assessed at age 9 via parent and teacher report. Results of latent growth curve models indicated that offspring Neuroticism, Conscientiousness, and Agreeableness mediated the link between early maternal depression and later childhood behavior problems, though results varied across maternal and teacher reports. Findings suggest that individual differences in youth personality and personality development are important predictors of emerging psychopathology among offspring of mothers diagnosed with depression.

Keywords

maternal depression; personality; development; psychopathology

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Offspring of mothers diagnosed with major depressive disorder (O-MD) are at a heightened risk for both internalizing and externalizing forms of psychopathology (Weissman et al., 2016). Previous studies have identified an array of mechanisms that may help to explain this link, including maternal affect (Rogosch, Cicchetti, & Toth, 2004), life stress (Hammen, Hazel, Brennan, & Najman, 2012), and parenting practices (Elgar, Mills, McGrath,

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Waschbusch, & Brownridge, 2007). Childhood personality has also been linked to maternal depression (e.g., Olino, Klein, Dyson, Rose, & Durbin, 2010) and to risk for the development of psychopathology in general (Oshri, Rogosch, Cicchetti, 2013). However, previous studies have yet to connect these two literatures. In the present study, we address this issue by examining associations between maternal depression, offspring personality development, and offspring psychopathology during the course of childhood.

Personality can be defined as relatively stable, characteristic patterns of thinking, feeling, and behaving (Funder, 2001). Traditionally, these types of individual differences have been studied under the rubric of temperament, with the implication being that early temperament traits might be more biologically-based than their adult counterparts, personality traits (e.g., Goldsmith et al., 1987). More recently, this distinction between temperament and personality has been challenged (for reviews, see De Pauw, 2017; Shiner & DeYoung, 2013). For instance, both temperament and personality traits are present from early in development (Abe, 2005), relatively stable over time (Denissen et al., 2013; Josefsson et al., 2013), and mutually influenced by both genetic and environmental factors (Krueger & Johnson, 2008; Saudino & Wang, 2012). The two sets of traits are also highly correlated (Grist & McCord, 2010) and share a similar hierarchical structure (De Pauw, Mervielde, & Van Leeuwen, 2009). In sum, there appears to be little support for a conceptual distinction between temperament and personality, though more work is needed to determine the exact structure of individual differences throughout development (Caspi & Shiner, 2006; Grist & McCord, 2010; Shiner & DeYoung, 2013). In the present study, we adopt a personality framework because the measure we use—the California Child Q-Sort—has its historical origins in the personality literature.

Though still a nascent area of research, studies examining the association between maternal depression and offspring personality are becoming more frequent. Neuroticism, which reflects individuals' tendencies to experience negative affect (Caspi & Shiner, 2006; Shiner & DeYoung, 2013), is the trait that has garnered the most attention to date, with meta-analytic work showing a small correlation between maternal depression and offspring negative affectivity (Goodman et al., 2011). Early differences in negative emotionality among O-MD appear to be important vulnerability factors for later maladjustment as well, as several studies have found that mothers' depressive symptoms are more strongly associated with internalizing and externalizing behavior problems in offspring who are higher in negative emotionality (Dix & Yan, 2014; Jessee, Mangelsdorf, Shigeto, Wong, 2012).

Maternal depression is also linked to deficits in cognitive control and self-regulation, processes typically reflected within the Big Five traits of Conscientiousness and Agreeableness. Several studies have shown that maternal depression is negatively associated with offspring effortful control (EC) and inhibitory control (IC), two temperament traits that most closely map on to Conscientiousness (Gagne, Spann, & Prater, 2013; Hughes, Roman, Hart, & Ensor, 2013). Lower EC in childhood, in turn, predicts heightened internalizing and externalizing symptoms later in development, especially in the context of maternal risk (Lengua, Bush, Long, & Trancik, 2008; Olson, Sameroff, Kerr, Lopez, & Wellman, 2005). Among O-MD specifically, one study found that lower IC at age 3 mediated the association

between early maternal depression and offspring conduct problems at age 4 (Choe et al., 2014).

Like Conscientiousness, Agreeableness also reflects individual differences in youths' capacity for self-regulation, but it places greater emphasis on the constraint of socially disruptive impulses, including aggression (Caspi & Shiner, 2006; Shiner & DeYoung, 2013). Agreeable youth tend to be described as kind, empathic, honest, and cooperative. To date, no research has explicitly examined childhood Agreeableness in the context of parental depression, but several studies have shown reduced empathy, higher aggression, and poorer emotion regulation among O-MD (Apter-Levy, Vakart, Ebstein, & Feldman, 2013; Malik et al., 2007; Maughan, Cicchetti, Toth, & Rogosch, 2007). Difficulties in emotion regulation may, in turn, explain why O-MD sometimes struggle to get along with peers (Luoma et al., 2001; Maughan et al., 2007; DeRose et al., 2014). Likewise, early irritability and anger, which frequently load on the Agreeableness domain in childhood, have been shown to mediate the association between maternal depression and offspring violence (Hay et al., 2003), suggesting that the emotional dysregulation that characterizes early Disagreeableness may portend later externalizing problems among O-MD.

Levels of a fourth Big Five domain, Extraversion (reflecting tendencies toward positive affect and assertiveness), may also be lower in O-MD than in offspring of healthy comparison mothers (O-HC). Several recent studies have found maternal depression is associated with low positive emotionality or positive affect among offspring (Durbin, Klein, Hayden, Buckley, & Moerk, 2005; Olino et al., 2011), though others have failed to find the effect (Dougherty, Klein, Olino, Dyson, & Rose, 2009; Pauli-Pott et al., 2004). It is also unclear how variation in Extraversion might, in turn, affect offspring behavior problems. In both children and adults, low Extraversion appears to have a unique association with depressive symptoms (Dougherty et al., 2010; Kotov, Gamez, Schmidt, & Watson, 2010). However, this association does not extend to the broader internalizing dimension, and so far, no studies have linked maternal depression and offspring Extraversion to later childhood psychopathology.

At this point, there are clear, but separate, bodies of evidence linking maternal depression to variation in offspring personality, and linking early personality to the emergence of psychopathology later in development. In the present study, we integrate these two lines of inquiry by examining whether early offspring personality characteristics—measured either as mean-level differences in early childhood or as longitudinal patterns of growth—underlie the association between maternal depression and later childhood symptoms of psychopathology. Though there is also growing interest in the effects paternal psychopathology (LeFrançois, 2010), we focus exclusively on maternal depression given its well-established impact on child development (Weissman et al., 2016) and connections to childhood temperament/personality. Specifically, we hypothesized that O-MD will exhibit heightened levels of Neuroticism during childhood. Higher Neuroticism will, in turn, predict offspring internalizing and externalizing symptoms later in childhood, consistent with evidence showing that Neuroticism is a general risk factor for all forms of psychopathology (Kotov et al., 2010). Based on previous findings (e.g., Feldman et al., 2009; Field et al., 1988), we anticipate that mean-level differences in Neuroticism will be present throughout

childhood, and as a result, we make no hypotheses about whether the development or growth of Neuroticism over the course of childhood will be related to maternal depression or childhood symptoms of psychopathology.

Second, we hypothesize that O-MD, compared to O-HC, will exhibit decreased Agreeableness and Conscientiousness during early and middle childhood. We also anticipate that maternal depression will predict less *development* of Conscientiousness and Agreeableness given research showing that self-regulatory processes often come on-line during the transition to middle childhood (Carlson, 2005; Eisenberg, Duckworth, Spinrad, & Valiente, 2014). Given research linking Effortful Control to both internalizing and externalizing problems (e.g., Lengua et al., 2008), we anticipate that both initial levels and growth in Conscientiousness during childhood will mediate relations between maternal depression and later offspring internalizing and externalizing problems. In contrast, we expect any mediating effect of Agreeableness to be confined to externalizing behavior (Miller, Lynam, & Jones, 2008).

Finally, we made no hypotheses regarding associations between the final two Big Five traits —Extraversion and Openness—and maternal depression or offspring psychopathology.

Method

Participants

Participants included mother-child dyads (total $N = 132$) enrolled in a longitudinal study examining the impact of parent-toddler psychotherapy on maternal depression and offspring development (Cicchetti, Rogosch, & Toth, 2000). In the present study, the depressed group ($N = 64$) consisted of mothers who were randomly assigned to the control arm of the study, and who were diagnosed with major depressive disorder (MDD) within one year following the birth of their child. Mothers in the healthy comparison group ($N = 68$) had no current or previous history of psychiatric illness. Mother-child dyads included in the intervention arm of the study were not included in this analysis. At the outset of this investigation, children were on average 20.59 months of age ($SD = 2.63$). Follow-up assessments occurred at ages 3 ($N = 110$), 4 ($N = 101$), 5 ($N = 99$), and 9 ($N = 97$). Just over half the children included in the sample were male (53.79%).

Sample recruitment—To control for the high co-occurrence of lower socioeconomic status and maternal depression (Downey & Coyne, 1990), included families could not be reliant on public assistance and parents were required to have at least a high school degree. A community sample of mothers with a history of MDD was recruited via referrals from local clinics and community notices. To recruit mothers in the nondepressed control group, names of potential families with a toddler-age child were obtained from birth records.

Mothers in the depressed group were required to meet *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed., rev.; *DSM–III–R;* American Psychiatric Association, 1987) criteria for MDD occurring at some time since the birth of their child. Interviewers determined depression status via administration of the Diagnostic Interview Schedule (DIS-III-R; Robins et al., 1985). Mothers who met criteria for bipolar affective disorder were not

retained. At the baseline assessment, 43.75% of mothers in the depressed group had met criteria for major depression within the last month, while 78.12% of mothers were depressed within the last six months. The average age of onset was 21.27 years. Most mothers (81.25%) reported recurrent depressive episodes during their lifetime. Mothers in the healthy comparison group were screened for current or past psychiatric disorders using the DIS-III-R; 21 mothers were excluded from the HC group because of a current or previous diagnosis.

Mother-child dyads included in each group were comparable on a range of demographic characteristics (see Table 1). The majority of families in the sample (71.97%) fell into the two highest tiers of the Hollingshead (1975) Four Factor Index of Social Status. About half of the mothers (51.51%) had earned a college degree. Most were of European American racial/ethnic background (91.67%). The majority (89.39%) were married at the time of initial recruitment. Depressed mothers tended to be younger than mothers in the healthy comparison group, $F_{(1,130)} = 7.41$, $p = .01$. They were also more likely to be divorced, separated, or never married compared to mothers in the healthy comparison group, $\chi^2_{(1)} = 12.35$, $p < .001$.

Procedure

Baseline and follow-up assessments—Approval for this research was obtained by the University of Rochester Institutional Review Board. All study procedures were in accordance with the ethical standards of the IRB and with the 1964 Helsinki declaration and its later amendments. Informed consent was attained from all mothers. Baseline visits were completed between 1991 and 1995. At the initial visit, families completed a series of home and laboratory-based assessments. Follow-ups occurred throughout childhood. Mothers rated their child's personality at each of the four time points following baseline. At age 9, both mothers and teachers completed measures assessing offspring internalizing and externalizing symptoms.

Measures

DIS-III-R (Robins et al., 1985)—The DIS-III-R is a structured psychiatric interview designed to assess diagnostic criteria for Axis I disorders of the DSM-III-R (American Psychiatric Association, 1987), which was the most up to date diagnostic manual at the onset of this longitudinal study. The DIS-III-R interview consists of a series of modules that probe the history of symptoms for different categories of Axis I disorders. Questions are answered on a yes/no basis, which eliminates error that can accompany subjective clinical ratings and allows for trained nonprofessional interviewers to reliably conduct the interview. The DIS-III-R also yields 49 DSM-III-R diagnoses via computer algorithm, diminishing the need for interrater reliability.

CCQ—The California Child Q-set (CCQ; Block & Block, 1969/1980) consists of 100 diverse items. Mothers rated their children in lab-based assessments at four time points by sorting individual items into a fixed distribution of piles depicting nine categories, from most characteristic (scored 9) to least characteristic (scored 1) of their child. The CCQ was recoded according to the procedure used by Soto (2016), who derived reliable and valid scales of each of the Big Five personality dimensions from the broader CCQ (as well as one

additional scale, activity level, that we did not examine here). One item (#41: "He/she is determined in what he/she does; he/she does not give up easily") was excluded from the Conscientiousness scale due to extremely low (or even negative) item-total correlations across all four time points ($r = < .10$).

CBCL—The parent form of the Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1983) was used to assess children's behavior problems. Mothers individually responded to 113 questions rated on a 3-point Likert scale ranging from *0 = Not True of My Child, 1 = Somewhat True of My Child*, and *2 = Very True of My Child*. The current study utilized raw scores from the internalizing and externalizing subscales of the CBCL.

TRF—The Achenbach Teacher Rating Form (TRF; Achenbach, 1991) includes 118 items describing common behaviors in children (e.g., *Impulsive or acts without thinking*). Teachers are instructed to respond to each item based on whether or not the description is a true reflection of the child's behavior, using a scale of *0 = Not True, 1 = Somewhat or Sometimes True*, or *2 = Very True or Often True*. Scores from the TRF were used only if the teacher had known offspring for a minimum of three months.

Analytic Plan

Latent growth curve modeling was conducted using MPlus version 6.00 (Muthén & Muthén, 2008–2012). A two-step procedure was used for evaluating the latent growth models (Duncan, Duncan, & Strycker, 2006). In the first step, we fit separate growth models for each trait across the four time points: 36m, 48m, 60m, and 108m. We evaluated the fit, unconditional functional form, and significance of the growth parameters. Growth parameters reflect the sample's initial status (intercept) and rate of change (slope) in the construct of interest (e.g., a Big Five domain). Second, we tested conditional models for each personality trait, in which maternal diagnostic status was added as the key predictor. Offspring sex was also included as a covariate. Separate conditional growth models were used to test for the indirect effect of maternal depression on childhood symptomatology through both the intercept and slope of each trait domain. Models examining maternal and teacher-rated behavior problems were examined independently.

Five growth curve models were used to model personality change in each dimension across four-time points. The first three time points were equidistant and approximately 12 months apart, while the last time point was 48 months later than the one preceding it. All intercept loadings were fixed to 1, while loadings on the slope factor were fixed in a proportional manner accordant with their proximity to one another and centered around age 5. Age 5 was selected as the centering point because personality is likely to be more fully differentiated at this time than at age 3 (Soto & John, 2014), and because it was the mid-point of the study and therefore most representative of average childhood individual differences. We evaluated the ability of each model to reproduce the data using a series of relative and absolute fit indices (Hu & Bentler, 1999): the Chi-Square Test of Model Fit $p < .05$, the Root Mean Square Error of Approximation $< .08$ (RMSEA), the close fit test ($p > .05$) the Comparative Fit Index $>.95$ (CFI), and the Tucker-Lewis Index $>.95$ (TLI).

The percentage of missing data on the CCQ at each time point was as follows: 16.67% at age 3, 24.24% at age 4, 25.00% at age 5, and 27.27% at age 9. Overall, 89 teachers completed the TRF (67.42%) and 97 mothers completed the CBCL (73.48%) at age 9. Examining the patterns of missingness using Little's MCAR test ($\chi^2_{(168)} = 163.83$, $p = .58$) yielded no evidence that missing data was related to the modeled variables, thereby supporting the assumption that data were missing completely at random (MCAR). Thus, all data were analyzed using Full Information Maximum Likelihood (FIML) estimation (Little & Rubin, 2002).

Maximum likelihood methods assume that the distribution of the continuous variables included in a model are multivariate normal. The normality assumption can be especially problematic in mediation models, as the product coefficients used to evaluate mediation rarely meet this assumption (Preacher & Hayes, 2008). As a result, both direct and indirect effects in the current study were evaluated via the bootstrapping technique (5,000 replicates), which is robust to problems of nonnormality typically present in product coefficient tests (MacKinnon, Fairchild, & Fritz, 2007).

Results

Descriptive statistics and bivariate correlations between the primary study variables are presented in Table S1 of our supplementary materials and Table 2 of this manuscript, respectively.

Direct Effects between Maternal Depression and Offspring Problems at Age 9

To determine whether maternal depression was associated with offspring internalizing and externalizing symptoms at age 9, we conducted a pair of multiple regressions covarying for offspring sex. O-MD ($M = 1.07$, $SD = 1.05$) experienced more externalizing problems at age 9 than O-HC based on maternal reports, ($M = .57$, $SD = .56$; $B = .50$, $SE = .17$, 95% CI = .20, .86), but not teacher reports (O-MD: $M = .83$, $SD = 1.23$; O-HC: $M = .54$, $SD = .78$; $B = .30$, $SE = .22$, 95% CI = −.09, .79). O-MD ($M = .81$, $SD = .60$) likewise experienced higher levels of internalizing problems at age 9 than O-HC ($M = .41$, $SD = .51$; $B = .40$, $SE = .11$, 95% CI = .18, .61) based on maternal, but not teacher reports (O-MD: $M = .56$ $SD = .50$; O-HC: $M = .51$, $SD = .62$; $B = .05$, $SE = .11$, 95% CI = −.19, .27). Sex did not predict offspring behavior problems.

Unconditional Latent Growth Curve Models

Individually varying trajectories of personality growth throughout early and middle childhood were modeled for each of the Big Five traits using an unconditional latent growth curve model. Unconditional models for four of the five traits demonstrated excellent fit (Table 3). The Openness model fit the data less well, though some indices were still in the acceptable range. In the Extraversion model, the residual variance of CCQ-Extraversion rated at age 9 was negative, a difficulty known as a Heywood case. Given that the residual variance was both small in magnitude and insignificant, it was fixed to 0 (Dillon, Kumar, & Mulani, 1987).

Results indicated negative growth in the linear trajectory of Extraversion ($B = -.06$, $SE = .02$, $p < .001$). In contrast, Agreeableness ($B = .05$, $SE = .01$, $p = < .001$), Neuroticism ($B = .07$, $SE = .02$, $p < .001$) and Conscientiousness ($B = .05$, $SE = .01$, $p < .001$) exhibited a trajectory defined by positive growth. Growth in Openness was not significant in either direction. These results reflect increases in Agreeableness, Conscientiousness, and Neuroticism, as well as decreases in Extraversion across the full sample. The variances of the intercepts of all five traits were significantly different from zero (Agreeableness, $\sigma^2 = .38$, $SE = .08$, $p < .001$; Neuroticism, $\sigma^2 = .17$, $SE = .03$, $p = < .001$; Conscientiousness, $\sigma^2 = .38$, $SE = .06$ $p < .001$; Extraversion, $\sigma^2 = .33$, $SE = .07$, $p < .001$; Openness, $\sigma^2 = .32$, $SE = .05$, $p < .001$) indicating substantial intra-individual variability in initial levels of personality. There was also significant variability in the growth slopes for Conscientiousness ($\sigma^2 = .02$, $SE = .01$, $p = .01$), Extraversion ($\sigma^2 = .02$, $SE = .01$ $p < .001$), and Neuroticism ($\sigma^2 = .02$, $SE = .01$, $p = .04$), suggesting variable growth in these traits across childhood. There was no significant variability in the slope term for Agreeableness or Openness.

Conditional Latent Growth Curve Mediation Models

Latent growth curve models for each of the Big Five were tested separately for both maternal and teacher reported behavior problems. Model fit statistics indicate good model fit for most models, though the Openness model was a poor fit to the data when using maternal ratings of behavior problems (Table 3). Tables 4 and 5 depict estimates of the relevant direct and indirect effects on maternal and teacher reported behavior problems, respectively. O-MD exhibited higher Neuroticism and lower Agreeableness at age 5 compared to their O-HC counterparts. In regards to personality growth, there were significant group differences only in the Conscientiousness domain, such that O-MD tended to show less growth in Conscientiousness than O-HC over the course of early and middle childhood. Offspring sex was related only to offspring Neuroticism, such that males were higher on Neuroticism at age 5 than females ($B = -.22$, $SE = .08$, 95% CI = $-.39$, $-.06$).

Offspring personality showed a range of associations with maternal reports of behavior problems, independent of group membership (see Table 4). Lower Neuroticism and higher Agreeableness and Conscientiousness at age 5 were associated with fewer internalizing and externalizing problems at age 9. Lower rates of growth in both Conscientiousness and Agreeableness also significantly predicted both internalizing and externalizing problems. Growth in Neuroticism positively predicted internalizing, but not externalizing, problems at age 9 across the full sample. Neither mean levels nor growth in Openness to Experience were related to internalizing or externalizing problems later in childhood.

Offspring personality was also related to teacher reports of behavior problems, though to a lesser extent. Conscientiousness at age 5 was negatively associated with teacher-reported externalizing problems at age 9. Growth in Conscientiousness across childhood was also negatively related to externalizing problems at age 9. Similarly, growth in Agreeableness was negatively related to teacher reports of both internalizing and externalizing problems.

Mediation Analysis—Longitudinal mediation analyses were conducted to determine if either initial trait levels or growth in personality across childhood mediated the relationship

between maternal depression and later offspring behavior problems. Models examining maternal reports of behavior problems (see Table 4) revealed that high offspring Neuroticism and low offspring Agreeableness at age 5 mediated the association between early maternal depression and both internalizing and externalizing problems at age 9. Similarly, growth in Conscientiousness mediated the association between maternal depression and later childhood internalizing and externalizing problems.

In models examining teacher ratings of behavior problems (see Table 5), growth in Conscientiousness once again mediated the link between maternal depression and later externalizing problems (but not internalizing problems). Similarly, growth in Agreeableness mediated the association between maternal depression and later childhood internalizing and externalizing problems. Note that the path from the independent variable (O-MD v. O-HC) to the mediatior (the slope of Agreeableness) was not statistically significant in the Agreeableness model using a 95% confidence interval, though it was when we relaxed our threshold for significance and used a 90% confidence interval instead ($B = -.04$, $SE = .03$, 95% CI = $-.10$, .003; 90% CI = $-.10$, $-.004$). Regardless, the significance of this path is not a prerequisite to mediation when using bootstrapped confidence intervals (Hayes, 2017).

Exploratory analyses investigating the potential indirect effects between maternal depression and offspring psychopathology via Extraversion and Openness yielded no significant findings, regardless of whether maternal or teacher reports were examined.

Discussion

The current study examined whether early individual differences in offspring personality traits mediate the association between maternal depression and later childhood symptoms of psychopathology. Maternal depression was associated with differences in both the organization and development of offspring personality traits. Variation in offspring personality, in turn, accounted for the well-known link between maternal depression and later childhood behavior problems. Nonetheless, observed effects often varied depending on whether mother or teacher ratings of internalizing and externalizing problems were used.

Consistent with our hypotheses, maternal depression was associated with less dramatic age-related increases in offspring Conscientiousness over the course of childhood. Growth in offspring Conscientiousness also mediated the association between early maternal depression and later childhood behavior problems, though the effect for internalizing problems was only present when using maternal ratings. Previous research has found that offspring EC mediates the link between maternal depression and externalizing problems in youth (Choe et al., 2014). However, this is the first study to show that maternal depression is associated with disturbances in the normative *development* of Conscientiousness/EC over the course of childhood. Neurobiological research has pointed to the prefrontal cortex (PFC) as an important neural substrate for Conscientiousness (Allen & DeYoung, 2017; DeYoung & Allen, in press). The PFC continues to show age-related developmental changes well into adolescence, and as a result, Conscientiousness may be more sensitive to developmental change than some of the other Big Five traits. Interestingly, two recent studies have linked maternal depression to cortical thinning of the frontal cortex in offspring, which could

reflect disturbances in the developmental course of synaptic pruning and myelination (Lebel et al., 2016; Sandman et al., 2015). In one of these studies (Sandman et al., 2015), cortical thickness mediated the association between maternal depression and offspring externalizing problems. Thus, one reasonable hypothesis might be that changes in Conscientiousness observed across childhood reflect underlying patterns of frontal cortex development. Research that incorporates repeated neuroimaging assessments would be helpful for testing this hypothesis.

Our results also provided evidence linking maternal depression to higher youth Neuroticism by age 5. Elevated Neuroticism, in turn, positively predicted mother rated internalizing and externalizing problems later in childhood. Previous studies have already shown that O-MD exhibit higher levels of negative emotionality compared to O-HC (Feldman et al., 2009; Olino et al., 2010), and high Neuroticism is also well-established as a general risk factor for psychopathology (Kotov et al., 2010). Our results integrate these two lines of inquiry by using a prospective design to formally test the mediating role of Neuroticism in the developmental pathway between maternal depression and offspring adjustment. It is noteworthy that mean-level differences, rather than growth in Neuroticism, were most relevant to the link between maternal depression and later adjustment. The longitudinal trajectory of Neuroticism is still likely to be important in predicting offspring adjustment, particularly during later developmental transitions (e.g. puberty). However, our findings indicate that mean-level differences, as opposed to growth in Neuroticism, are most predictive of childhood behavior problems among O-MD. Even subclinical elevations in early negative affect may therefore signal a need for preventative efforts. Research that can help to understand the mechanisms by which maternal depression leads to increased negative affect among offspring may help to generate preventive intervention targets (e.g., negative parenting) that when addressed, could lead to reductions in offspring Neuroticism prior to the emergence of pathology.

Agreeableness also appears to have an important role in the developmental pathway between maternal depression and offspring adjustment, though our results varied substantially depending on whether maternal or teacher ratings of behavior problems were used. For maternal ratings, we found that low Agreeableness at age 5 mediated the association between maternal depression and both internalizing and externalizing behavior problems later in childhood. This finding did not generalize to teacher reports, though the effect for externalizing problems would have been significant had we used a 90% confidence interval as opposed to 95% (90% CI = .02, .30). In contrast, *growth* in Agreeableness mediated the link between maternal depression and teacher ratings of internalizing and externalizing problems. Notably, growth in Agreeableness was also associated with maternal reports of behavior problems, though we found no found evidence of mediation in models that used maternal ratings. Taken together, low Agreeableness at age 5 and less growth in Agreeableness across childhood likely portend later behavior problems, particularly within the externalizing dimension, which has been consistently linked to low Agreeableness (Miller et al., 2008). The effect of Agreeableness on internalizing problems was more surprising, and likely requires replication before firmer conclusions can be drawn. It is possible that less dramatic increases in Agreeableness during childhood reflect the development of interpersonal difficulties, which in turn have been shown to be strong

predictors of depression among O-MD (Hammen, Shih, & Altman, 2003). Given the discrepancy we observed across raters, research with larger samples will also be needed to clarify whether the link between maternal depression and childhood behavior problems is best explained by mean-levels or growth of Agreeableness (or both, potentially).

Finally, maternal depression was unrelated to individual differences in offspring Extraversion and Openness in our sample. Though maternal depression has been linked to lower Extraversion in offspring (Durbin et al., 2005; Olino et al., 2011), this finding is not consistently present (e.g. Dougherty et al., 2009; Pauli-Pott et al., 2004). The few studies that have linked maternal depression to decreased Extraversion focused specifically on positive emotionality, a component of Extraversion that is notably absent on the CCQ. Additional research that employs personality measures assessing lower-order traits of each of the Big Five domains is likely to be especially helpful in understanding whether there are any relations between maternal depression, offspring Extraversion, and later adjustment. Studies that assess risk for specific symptom dimensions might also be helpful given evidence for a specific link between low Extraversion and depression (Kotov et al., 2010).

Several important limitations to this study are worthy of mention. First, though the use of maternal and teacher ratings of behavior problems was a considerable strength to the study, it also led to several instances of discrepant results. Some of these discrepancies could certainly stem from what scholars have dubbed the depression→distortion effect, in which depressed mothers rate their offspring more negatively than healthy comparison mothers (Gartstein, Bridgett, Dishion, & Kaufman, 2009). Nonetheless, a recent review of the literature on this effect suggested it lacks firm empirical support (De Los Reyes et al., 2015), and others have noted that if an effect is present, it is likely both modest in size and variable across offspring gender and type of behavior problems (Gartstein et al., 2009). Mothers' and teachers' perspectives may diverge for other reasons as well, including variability in their amount of contact with offspring, context-specific change in offspring behavior, or differing accessibility to offsprings' mental states. As a result, it is difficult to know the true source of the discrepancies we observed between maternal and teacher ratings, and it is possible both sources provide unique and valid information. Future research could address this issue in greater depth by collecting data from additional informants (e.g., fathers, self-report) and employing a latent variable approach to minimize measurement error.

This study also featured a limited sample size, and as a result, we may have been underpowered to detect small to moderate effects. For instance, the middle third of effect sizes in psychology are between $r = .2$ and $.3$ (Hemphill, 2003). With a sample size of 132, we would have about a 65% chance of detecting a true correlation of $r = .2$, but a 94% chance of detecting a true correlation of $r = .3$. Future research on larger samples will be helpful in detecting effect sizes closer to $r = .2$ and below. Finally, our sample consisted almost exclusively of white, middle-class families, which may limit the extent to which our findings generalize to more diverse samples. This is a particularly pressing issue given research showing that maternal depression is more prevalent among mothers who are African American, less educated, unmarried, or of lower socioeconomic status (Darcy et al., 2011). Previous research has shown that certain demographic characteristics, including family income and the presence of a healthy co-parent, can lessen the impact of maternal

depression on youth adjustment (Vakrat, Apter-Levy & Feldman, 2018; Petterson & Albers, 2001). As a result, we would speculate that our own findings may actually underestimate the effect of maternal depression on offspring personality development and adjustment, given that most of the mothers included were married and of middle to high socioeconomic status. Nonetheless, additional work will be needed to confirm this speculation in more demographically diverse samples.

The results of the present study provide compelling evidence that a history of maternal depression alters the organization and development of offspring personality traits. More broadly, they add to a still nascent literature examining how personality development prospectively contributes to the emergence of psychopathology. To this end, our results are likely to have implications for newly emerging dimensional models of psychopathology, in which formal mental disorders are hypothesized to arise from the kinds of disturbances in personality and personality development that we observed here. Our findings may also provide incremental clinical utility by drawing attention to the personality impairments that are most likely to portend psychopathology among O-MD. Identification of high-risk trait profiles among O-MD may be helpful in singling out youth at greatest need for preventive intervention. Conversely, including youth personality assessments in interventions targeting maternal depression might also be helpful for determining whether treatment-induced symptom reduction is associated with beneficial changes in offspring personality. In general, additional research is needed to understand the specific biological and environmental (e.g., parenting, attachment) mechanisms by which maternal depression can affect offspring personality. Not all forms of depression are the same, and research should consider whether variables like timing, chronicity, and episode duration moderate our own findings. Similarly, additional research is needed to better characterize transactional links between maternal depression and offspring personality, particularly in light of research showing that youth personality traits elicit more negative parenting behaviors in the context of high maternal symptoms (Dix & Yan, 2014). Indeed, maternal symptoms and childhood personality traits are likely to have reciprocal influences on one another, and study designs that include repeated measures of both constructs would be helpful in disentangling these effects. Such research is likely to inform basic research into the origins of psychopathology among offspring of mothers with depression, as well as more translational efforts aimed at prevention and intervention within at-risk offspring.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Table 1

Demographics of Mother-Child Dyads in the O-HC and O-MD Groups

Child Characteristics	O-HC	O-MD
N at T1	68	64
N at T2	59	51
N at T3	56	45
N at T4	56	43
N at T5	53	50
Female (%)	30 (44.12%)	31 (48.44%)
Age at T1 in Months (SD)	20.93 (2.87)	20.23 (2.32)
Age at T2 in Months (SD)	38.18 (1.99)	38.06 (2.24)
Age at T3 in Months (SD)	49.70 (1.53)	49.73 (1.69)
Age at T4 in Months (SD)	61.88 (2.86)	61.67 (2.95)
Age at T5 in Months (SD)	113.76 (12.88)	111.75 (8.27)
Maternal Characteristics		
Age at T1 in Years (SD)	32.78 (4.03)	30.66 (4.91)[*]
Race		
Black (%)	2 (2.94%)	5 (7.81%)
Pacific Islander (%)	1 (1.47%)	0 (0%)
White (%)	65 (95.59%)	57 (89.06%)
Other (%)	0 (0%)	2 (3.12%)
Ethnicity		
Hispanic (%)	0 (0%)	3 (4.69%)
Marital Status T1 (%)		
Married	67 (98.53%)	51 (79.69%)[*]
Divorced	0 (0%)	5 (7.81%)
Separated	0 (0%)	3 (4.69%)
Never Married	1 (1.47%)	5 (7.81%)
Education T1 (%)		
High School Degree	11 (16.18%)	11 (17.19%)
Partial College	25 (36.76%)	17 (26.56%)
College Degree	22 (32.35%)	23 (35.94%)
Graduate Degree	10 (14.71%)	13 (20.31%)
Highest Grade T1 (SD)	14.71 (1.70)	14.95 (1.79)
Family SES T1 (SD)	48.56 (10.46)	45.73 (11.40)

Note:

[*] Difference between groups is significant at $p < .05$.

Table 2

Correlations between Maternal Depression, the Big Five, and Offspring Symptoms

	1	2	3	4	5	6	7	8	9	10	11	12
1. Group (HC = 0, MD = 1)	---											
2. Offspring Age at T1	-.13	---										
3. Offspring Sex (M = 0, F = 1)	.04	.11	---									
4. Neuroticism	.35**	-.14	-.18*	---								
5. Extraversion	-.09	-.02	.03	-.18	---							
6. Openness	.16	-.11	.10	-.20*	.19*	---						
7. Agreeableness	-.19*	.07	.13	-.36**	-.16	.14	---					
8. Conscientiousness	-.15	.12	.00	-.43**	-.25**	.10	.65**	---				
9. MR – Internalizing	.34**	-.03	-.10	.53**	-.05	.01	-.40**	-.31**	---			
10. MR – Externalizing	.28**	.09	-.10	.35**	.16	-.11	-.68**	-.49**	.63**	---		
11. TR – Internalizing	.04	-.02	-.13	.05	-.06	.02	.02	-.10	.13	.11	---	
12. TR – Externalizing	.13	-.04	-.13	.20	.13	-.03	-.27*	-.41**	.38**	.65**	.46**	---

Note:

*
$p < .05$,

**
$p < .01$.

Abbreviations: O-HC = offspring of healthy comparison mothers; O-MD = offspring of mothers diagnosed with depression.

Table 3

Model Fit Statistics for Unconditional and Conditional Latent Growth Models

	Neuroticism	Extraversion	Conscientiousness	Agreeableness	Openness
Unconditional Models					
$\chi^2(p)$	3.27 (.66)	4.43 (.62)	.73 (.98)	2.57 (.77)	13.53 (.02)
CFI	1.00	1.00	1.00	1.00	.93
TLI	1.08	1.03	1.04	1.02	.92
RMSEA	<.001	<.001	<.001	<.001	.12
Test of Close Fit	.78	.76	.99	.86	.06
Conditional Models: Maternal Ratings					
$\chi^2(p)$	16.71 (.27)	13.15 (.59)	16.19 (.30)	21.85 (.13)	27.38 (.02)
CFI	.99	1.00	.99	.98	.93
TLI	.97	1.02	.99	.97	.87
RMSEA	.04	<.001	.03	.06	.09
Test of Close Fit	.57	.84	.60	.39	.11
Conditional Models: Teacher Ratings					
$\chi^2(p)$	15.13 (.37)	10.32 (.80)	14.85 (.39)	11.53 (.71)	20.73 (.11)
CFI	.99	1.00	1.00	1.00	.95
TLI	.98	1.07	.99	1.03	.91
RMSEA	.03	<.001	.02	<.001	.06
Test of Close Fit	.67	.94	.68	.90	.34

Note: df = degrees of freedom, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation.

Table 4

Path Estimates for Structural Models of Maternal Depression, Big Five, and Offspring Behavior Problems Rated by Mothers

	Neuroticism			Conscientiousness			Agreeableness		
	B (β)	SE	B 95% CI	B (β)	SE	B 95% CI	B (β)	SE	B 95% CI
Direct Effects									
Group (O-MD = 1) to Int.	.35 (.43)	.08	[.19, .50]	−.15 (−.13)	.12	[−.40, .09]	−.27 (−.22)	.12	[−.51, −.03]
Group to Slope	.01 (.05)	.03	[−.05, .07]	−.07 (−.30)	.03	[−.12, −.01]	−.04 (−.26)	.03	[−.09, .01]
Group to INT	.15 (.13)	.18	[−.30, .41]	.24 (.20)	.19	[−.30, .49]	.15 (.13)	.17	[−.30, .40]
Group to EXT	.29 (.17)	.21	[−.15, .68]	.25 (.15)	.22	[−.23, .58]	−.08 (−.05)	.21	[−.55, .28]
Intercept to INT	.62 (.44)	.20	[.31, 1.11]	−.19 (−.20)	.09	[−.39, −.04]	−.30 (−.32)	.12	[−.58, −.12]
Slope to INT	3.02 (.55)	2.50	[1.29, 10.51]	−2.19 (−.41)	2.43	[−12.13, −.47]	−4.32 (−.54)	1.87	[−8.98, −1.30]
Intercept to EXT	.56 (.26)	.31	[.06, 1.28]	−.66 (−.47)	.18	[−1.09, −.35]	−.88 (−.64)	.14	[−1.15, −.60]
Slope to EXT	1.46 (.18)	2.65	[−1.89, 8.75]	−2.59 (−.33)	3.05	[−14.53, −.41]	−8.67 (−.75)	1.66	[−13.08, −6.17]
Indirect Effects									
Group to INT via Int.	.22 (.19)	.10	[.08, .49]	.03 (.03)	.03	[−.01, .12]	.08 (.07)	.05	[.01, .21]
Group to INT via Slope	.03 (.03)	.14	[−.23, .32]	.16 (.12)	.16	[.02, .75]	.16 (.14)	.14	[−.01, .59]
Group to EXT via Int.	.20 (.11)	.13	[.02, .55]	.09 (.06)	.09	[−.04, .33]	.23 (.14)	.12	[.03, .51]
Group to EXT via Slope	.01 (.01)	.10	[−.08, .37]	.20 (.10)	.20	[.02, 1.00]	.33 (.19)	.25	[−.08, .91]

	Extraversion			Openness to Experience		
	B (β)	SE	B 95% CI	B (β)	SE	B 95% CI
Direct Effects						
Group to Intercept	−.11 (−.09)	.12	[−.34, .13]	.19 (.17)	.12	[−.06, .41]
Group to Slope	−.02 (−.05)	.03	[−.08, .05]	.03 (.18)	.03	[−.03, .09]
Group to INT	.39 (.33)	.11	[.17, .60]	.42 (.36)	.14	[.19, .73]
Group to EXT	.55 (.31)	.17	[.26, .92]	.60 (.34)	.24	[.21, 1.17]
Intercept to INT	.04 (.04)	.13	[−.17, .34]	−.04 (−.04)	.11	[−.25, .18]
Slope to INT	−.81 (−.20)	.56	[−2.12, .07]	−.50 (−.07)	1.79	[−6.02, 1.65]
Intercept to EXT.	.25 (.16)	.22	[−.09, .75]	−.26 (−.17)	.20	[−.68, .11]
Slope to EXT	.57 (.10)	1.20	[−2.35, 2.29]	−1.46 (−.14)	3.08	[−13.94, .83]
Indirect Effects						
Group to INT via Int.	−.004 (−.003)	.02	[−.07, .02]	−.01 (−.01)	.03	[−.08, .03]

	Extraversion			Openness to Experience		
	B (β)	SE	B 95% CI	B (β)	SE	B 95% CI
Group to INT via Slope	.01 (.01)	.04	[−.03, .12]	−.02 (−.01)	.07	[−.39, .03]
Group to EXT via Int.	−.03 (−.02)	.04	[−.17, .03]	−.05 (−.03)	.05	[−.23, .01]
Group to EXT via Slope	−.01 (−.01)	.04	[−.14, .04]	−.04 (−.03)	.14	[−.92, .03]

Notes: Standardized coefficients are listed in parentheses. Group is coded 0 = O-HC and 1 = O-MD. Abbreviations: INT = Internalizing problems; EXT = Externalizing problems; MDD = maternal depressive disorder; Int = Intercept.

Table 5

Path Estimates for Structural Models of Maternal Depression, Big Five, and Offspring Behavior Problems Rated by Teachers

	Neuroticism			Conscientiousness			Agreeableness		
	B (β)	SE	B 95% CI	B (β)	SE	B 95% CI	B (β)	SE	B 95% CI
Direct Effects									
Group (O-MD = 1) to Int.	.36 (.44)	.08	[.19, .51]	−.15 (−.13)	.13	[−.40, .08]	−.28 (−.23)	.12	[−.52, −.05]
Group to Slope	.01 (.06)	.03	[−.05, .08]	−.07 (−.31)	.03	[−.12, −.01]	−.04 (−.54)	.03	[−.10, .003]
Group to INT	.05 (.05)	.17	[−.29, .36]	−.002 (−.002)	.15	[−.33, .24]	−.25 (−.22)	.21	[−1.34, −.05]
Group to EXT	.15 (.07)	.32	[−.50, .75]	.04 (.02)	.31	[−.74, .44]	−.82 (−.40)	.47	[−2.72, −.29]
Intercept to INT	−.01 (−.01)	.23	[−.45, .44]	−.09 (−.10)	.11	[−.30, .12]	.05 (.05)	.13	[−.20, .31]
Slope to INT	.68 (.12)	1.59	[−1.58, 4.22]	−.76 (−.14)	1.52	[−4.94, .98]	−7.26 (−.53)	3.36	[−18.13, −4.08]
Intercept to EXT	.38 (.15)	.47	[−.45, 1.47]	−.60 (−.36)	.25	[−1.24, −.21]	−.39 (−.23)	.27	[−.96, .08]
Slope to EXT	1.39 (.13)	4.72	[−3.79, 17.22]	−3.14 (−.32)	4.32	[−19.99, −.07]	−22.58 (−.91)	8.05	[−43.04, −13.95]
Indirect Effects									
Group to INT via Int.	−.003 (−.003)	.08	[−.17, .17]	.02 (.01)	.02	[−.01, .09]	−.01 (−.01)	.04	[−.12, .04]
Group to INT via Slope	.01 (.01)	.06	[−.04, .21]	.10 (.04)	.10	[−.04, .37]	.32 (.28)	.21	[.10, 1.48]
Group to EXT via Int.	.14 (.07)	.19	[−.14, .63]	.09 (.05)	.09	[−.02, .36]	.11 (.05)	.08	[−.001, .35]
Group to EXT via Slope	.02 (.01)	.16	[−.11, .68]	.30 (.10)	.30	[.003, 1.50]	1.00 (.49)	.49	[.43, 3.11]

	Extraversion			Openness to Experience		
	B (β)	SE	B 95% CI	B (β)	SE	B 95% CI
Direct Effects						
Group to Intercept	−.11 (−.09)	.12	[−.34, .13]	.19 (.17)	.12	[−.06, .41]
Group to Slope	−.02 (−.06)	.03	[−.08, .05]	.03 (.18)	.03	[−.03, .09]
Group to INT	.05 (.04)	.13	[−.21, .29]	.03 (.03)	.15	[−.29, .29]
Group to EXT	.33 (.16)	.21	[−.05, .80]	.32 (.16)	.29	[−.14, 1.01]
Intercept to INT	−.08 (−.08)	.13	[−.33, .18]	.02 (.02)	.12	[−.20, .29]
Slope to INT	.10 (.03)	.58	[−1.11, 1.06]	.68 (.10)	1.89	[−2.22, 5.85]
Intercept to EXT.	.27 (.15)	.17	[−.03, .64]	−.07 (−.04)	.20	[−.42, .37]
Slope to EXT	−.13 (−.02)	1.43	[−3.50, 2.16]	−.52 (−.04)	4.26	[−13.29, 5.29]
Indirect Effects						
Group to INT via Int.	.01 (.01)	.02	[−.02, .09]	.004 (.004)	.03	[−.04, .08]

	Extraversion			Openness to Experience		
	B (β)	*SE*	*B* 95% CI	*B* (β)	*SE*	*B* 95% CI
Group to INT via Slope	−.002 (−.001)	.02	[−.07, .02]	.02 (.02)	.08	[−.04, .34]
Group to EXT via Int.	−.03 (−.01)	.04	[−.16, .03]	−.01 (−.01)	.05	[−.15, .05]
Group to EXT via Slope	.002 (.001)	.05	[−.08, .16]	−.02 (−.01)	.18	[−.87, .13]

Notes: Standardized coefficients are listed in parentheses. Group is coded 0 = O-HC and 1 = O-MD. Abbreviations: INT = Internalizing problems; EXT = Externalizing problems; MDD = maternal depressive disorder; Int = Intercept.