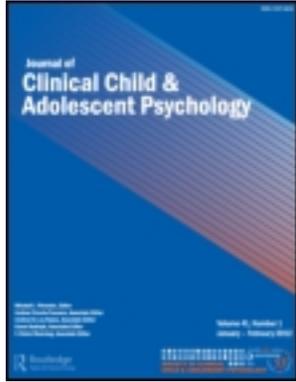


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### Disentangling the Temporal Relationship Between Parental Depressive Symptoms and Early Child Behavior Problems: A Transactional Framework

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## DISRUPTIVE BEHAVIORS

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# Disentangling the Temporal Relationship Between Parental Depressive Symptoms and Early Child Behavior Problems: A Transactional Framework

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Despite the considerable amount of research demonstrating the relationship between parental depressive symptoms and child behavior problems, few studies have examined the direction of the relationship between these variables. Therefore, the purpose of this study was to examine transactional effects between parental depressive symptoms and child behavior problems. Participants were 209 parent–child dyads drawn from the Oregon Adolescent Depression Project who completed at least 2 of 4 annual questionnaire assessments between the child’s age of 4 and 7 years. Structural equation modeling was used to examine the autoregressive paths from one year to the next year within each construct, as well as cross-lagged paths from one year to the next year between constructs. Findings indicated that parental depressive symptoms at each year predicted child behavior problems at the subsequent year and vice versa. No support was found for differential gender effects. These findings highlight the reciprocal relationship between parental depressive symptoms and child behavior problems and suggest intervention programs for young children should assess for and target parental depression when appropriate. Future research should examine these relationships across a broader developmental spectrum and in more diverse, heterogeneous samples.

Depression is one of the most common psychiatric disorders with lifetime prevalence rates as high as 41.4% when using prospective report in comparison to rates in the range of 15 to 20% when using retrospective report (Kessler et al., 2005; Moffitt et al., 2010). In particular, depression is common among parents following childbirth for both mothers and fathers (Goodman, 2004; Vesga-Lopez et al., 2008). For parents

with elevated depressive symptoms during the prenatal period and shortly after birth, the depressive symptoms are likely to recur and persist during the postpartum year (Ballard, Davis, Cullen, Mohan, & Dean, 1994; Zerkowitz & Milet, 2001) and throughout the child’s pre-school years (Horwitz, Briggs-Gowan, Storfer-Isser, & Carter, 2009; Josefsson & Sydsjo, 2007). Given the high prevalence of parental depressive symptoms and associated negative outcomes among both parents and their young children, the purpose of the current study was to examine the transactional relationship between parental depression and child behavior problems.

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## RELATIONSHIP BETWEEN PARENTAL DEPRESSION AND CHILD BEHAVIOR PROBLEMS

Most previous work examining the effect of parental depression on child outcomes has focused primarily on mothers. Research has demonstrated a positive relationship between maternal depression and negative child behavioral outcomes from infancy (e.g., avoidant and disorganized attachment; Martins & Gaffan, 2000) through adolescence (e.g., behavior problems; Aisenberg, Trickett, Mennen, Saltzman, & Zayas, 2007; Beck, 1999). Chronic maternal depression has also been associated with increased parent and teacher report of child internalizing and externalizing behavior problems (Trapolini, McMahon, & Ungerer, 2007), as well as child physiological response to stress (Gump et al., 2009).

Among fathers, research has demonstrated a link between depression and preschool-age behavior problems (Ramchandani, Stein, Evans, & O'Connor, 2005), as well as father-child conflict (Kane & Garber, 2004). In a longitudinal Canadian study, parental nurturance, rejection, and monitoring mediated the effect of both mother and father depressive symptoms on child behavior problems (Elgar, Mills, McGrath, Waschbusch, & Brownridge, 2007). In a meta-analysis, Connell and Goodman (2002) concluded both that maternal and paternal depressive symptoms are both significantly related to child behavior problems and that the association during early childhood is greater for mothers than fathers. This gender difference may be due in part to the tendency for mothers to spend more time with young children (Connell & Goodman, 2002). Alternatively, there may be more variability in mothers' than fathers' depressive symptoms given the higher prevalence of depressive disorders in females than males (Nolen-Hoeksema, 2001). Overall, research supports the inclusion of both mothers and fathers in research examining the relations between parental depression and child outcomes but also indicates that the magnitude of the relations may be stronger for mothers than fathers.

Similarly, research indicates that parental depression is significantly associated with early childhood behavior problems in girls and boys, but the effects of parental depression may be strongest on boys during early and middle childhood and strongest on girls during adolescence (Cummings & Davies, 1999). However, other research has suggested that gender did not moderate the association between parental depressive symptoms and internalizing and externalizing behavior problems in kindergarteners (Cummings, Keller, & Davies, 2005). Therefore, the extent to which such parent-child gender matching effects may occur at the

level of child behavior problems remains unclear. Nevertheless, these findings highlight the importance of including boys and girls and testing gender moderation when investigating the impact of parental depressive symptoms on childhood behavior (Connell & Goodman, 2002).

In addition to the effect of parental depressive symptoms on child behavior, some research, albeit limited, has focused on the effect of child behavior problems on parental depressive symptoms. Mothers of children with psychiatric problems have been shown to be at risk for increased mental distress (Syed & Zuberi, 2006) and depression (Fergusson, Lynskey, & Horwood, 1993). Based on a representative U.S. sample, mothers reporting more behavioral and emotional problems in their child were also more likely to report higher levels of depressive symptoms (Civic & Holt, 2000). In addition, improvements in child and adolescent behavior problems following treatment have been associated with decreases in maternal depressive symptoms (Bagner & Eyberg, 2003; Grimbos & Granic, 2009). Despite the considerable research in this area, much of the work previously reviewed has been cross-sectional, which limits conclusions about the directionality of the relationship between parental depression and child behavior.

## TRANSACTIONAL MODEL OF PARENTAL DEPRESSION AND CHILD BEHAVIOR PROBLEMS

One way to evaluate directionality is to examine the transactional relationship between parental depressive symptoms and child behavior using multiwave designs (Goodman & Gotlib, 1999). Sameroff's (1975, 1995) depiction of a transactional model focused on the complex influence that child behavior has on parental behavior and vice versa. Transactional processes similar to those depicted in Sameroff's model have been examined extensively in the context of parenting behaviors and child externalizing behavior problems (Danforth, Barkley, & Stokes, 1991; Greene & Doyle, 1999; Johnston & Mash, 2001), with the majority of findings supporting bidirectional, reciprocal paths between parenting behaviors and child behavior problems (Bates, Pettit, Dodge, & Ridge, 1998; Burt, McGue, Krueger, & Iacono, 2005; O'Connor, Deater-Deckard, Fulker, Rutter, & Plomin, 1998).

Theoretically, the transactional model fits well with the relationship between parental depressive symptoms and child behavior. For example, parental depression is associated with a number of parenting behaviors, which may lead to escalated child behavior problems (Goodman & Tully, 2008). These include high levels of hostility and criticism (Lovejoy, Graczyk,

O'Hare, & Neuman, 2000) and fewer displays of warmth toward the child (Alloy, Abramson, Smith, Gibb, & Neeren, 2006), as well as disengagement from the child (Lovejoy et al., 2000). The increased child behavior problems may, in turn, lead to an increase in parental depressive symptoms (Pelham et al., 1997), but this reverse path has received little empirical attention. Recent research has demonstrated that maternal depression predicted increased conduct problems, whereas positive parenting during a parent-child interaction task predicted fewer conduct problems, suggesting parenting did not fully mediate the effect of maternal depression (Chronis et al., 2007). However, to our knowledge, a reciprocal paths model has been tested only in the area of parental depressive symptoms and child behavior in three recent studies from the same research group with two independent samples.

One study (Gross, Shaw, Moilanen, Dishion, & Wilson, 2008) used latent growth curve modeling to test transactional models of child noncompliance at 2 years; child internalizing and externalizing behavior problems at 4 years; and parental depressive symptoms at child ages 2, 3, and 4 years. Findings demonstrated that child noncompliance at 2 years was significantly associated with concurrent maternal depressive symptoms, which was, in turn, related to child internalizing and externalizing behavior problems at 4 years. There was a trend-level concurrent association between paternal depressive symptoms and child noncompliance at 2 years, and paternal depressive symptoms at 2 years was significantly associated with child internalizing behavior problems at 4 years. Although the theoretical model in this study was transactional, the authors were unable to examine the effect of child behavior on later parental depression due to a nonsignificant slope variance in depressive symptoms.

Another study (Gross, Shaw, Burwell, & Nagin, 2009) used a larger age range and examined the effect of boys' behavior problems from 18 months to adolescence on maternal depressive symptoms. Boys' noncompliance at 18 months was the strongest predictor of mothers with more severe and chronic trajectories of depressive symptoms. In turn, maternal status of moderately high trajectories of depressive symptoms predicted teacher and youth self-report of externalizing behavior problems during adolescence. However, trajectory status of maternal depressive symptoms did not predict internalizing behavior problems. Although this study provided valuable information about the course of maternal depressive symptoms over approximately 10 years and included teacher report of child behavior problems, it did not address ongoing proximal and reciprocal effects between parental depression and child behavior problems during the preschool and school years and focused only on mothers.

Finally, Gross, Shaw, and Moilanen (2008) used latent growth curve modeling to measure ongoing proximal and reciprocal associations between boys' externalizing behavior problems, throughout both school age and adolescent periods, and maternal depressive symptoms. Results provided support for the bidirectional relationship between child aggression and maternal depressive symptoms from child ages 5 to 6 years and the bidirectional relationship between child antisocial behavior and maternal depressive symptoms from child ages 11 to 12 years. The findings support the transactional effects of child externalizing behavior problems and maternal depressive symptoms at important child transitions (i.e., start of school and entry into adolescence). However, the study did not examine child internalizing behavior problems and did not include fathers or girls in the sample.

## THE CURRENT STUDY

In summary, the small body of existing research provides some support for a transactional model of parental depressive symptoms and child behavior problems but is limited in several important ways as previously described, including a paucity of empirical investigations on transactional relationships between depressive symptoms and child *internalizing* behavior problems, reliance on *maternal* depressive symptoms, and a primary focus on *boys* from at-risk samples. The primary purpose of the current study was to extend the previous research on the transactional relationship between parental depressive symptoms and child behavior while addressing these limitations. In particular, we examined reciprocal effects between mother and father depressive symptoms and a latent factor of child behavior problems, including internalizing and externalizing problems as indicators, in the context of a multiwave design that tracked boys and girls from ages 4 to 7 years. In contrast to other studies on transactional processes that sampled from high-risk populations (Gross, Shaw, & Moilanen, 2008; Gross, Shaw, Moilanen, Dishion, et al., 2008; Gross et al., 2009), the sample for the present study was selected from a school-based sample representative of western Oregon. Given the limited research in this area, it is important to examine whether transactional processes found in high-risk settings extend to more representative samples in other settings.

The developmental period between ages 4 to 7 years reflects the transition from preschool to elementary school, in which the nature of relationships with others plays a critical role in long-term child outcomes (Rimm-Kaufman & Pianta, 2000). In addition, negative and inconsistent parenting during the preschool years is associated with the persistence of behavior problems in

school-age children (Campbell, 1995), and prior research indicates that more impaired parent-child interactions are seen among depressed mothers and fathers (Jacob & Johnson, 1997). Therefore, elevated parental depressive symptoms during this key developmental period may interfere with the emotional and behavioral development of their children. Based on past research (Hammen & Brennan, 2003; Hay, Pawlby, Angold, Harold, & Sharp, 2003; Marchand, Hock, & Widaman, 2002), we hypothesized that higher levels of parental depressive symptoms would prospectively predict higher levels of child behavior problems.

As previously described, little research has investigated the path from child behavior to parental depressive symptoms. Based on a transactional model (Sameroff, 1975) and the small body of past work (Gross, Shaw, & Moilanen, 2008; Gross, Shaw, Moilanen, Dishion, et al., 2008; Gross et al., 2009), we hypothesized that child behavior problems would prospectively predict higher levels of parental depressive symptoms. Prior research has provided glimpses into potential child and parent gender differences in transactional processes, but there is little conclusive work to guide specific hypotheses at this time. Thus, we examined child gender as a moderator of transactional processes in an exploratory manner. For parent gender, we examined transactional processes in the total sample and specifically among mothers. The number of fathers in the present study ( $n = 59$ ; 28%) was insufficient to perform formal tests of moderation.

## METHOD

### Sampling Strategy

Participants were drawn from the Oregon Adolescent Depression Project (OADP), which began as a random sample of adolescents from nine high schools in western Oregon. After a description of the study, written informed consent was obtained and participants were remunerated for their participation. This research was approved by an Institutional Review Board. A total of 1,709 adolescents ( $M$  age = 16.60 years;  $SD = 1.19$ ; range = 13.89–20.01; 52.2% female; 91.1% Caucasian) completed an initial assessment (T1) between 1987 and 1989. Approximately 1 year later, 1,507 returned for a second evaluation (T2) at which the mean age was 17.67 years ( $SD = 1.21$ ; range = 14.90–21.18). Differences between the sample and the larger population from which it was selected, and between participants and those who declined or dropped out before T2, were small (Lewinsohn, Hops, Roberts, Seeley, & Andrews, 1993). At 24 years of age, all participants with a history of Axis I disorders and a random sample with no history

of mental illness by T2 ( $n = 457$ ) were invited to participate in a third evaluation (T3) between 1993 and 1999. Of the 1,101 participants selected for a T3 interview, 941 completed the evaluation. At 30 years of age, all 941 T3 participants were invited to a T4 evaluation, and 816 completed the T4 diagnostic interview. Among those invited to T3 and T4 assessments, women were more likely than men to complete evaluations ( $\chi^2_s > 5.99$ ,  $ps < .05$ ); however, participation did not differ as a function of other status variables or previous diagnoses.

In addition to the four major assessments (T1–T4), participants completed a mailer questionnaire annually for up to 7 years. The mean age range for the mailers spanned from 21.58 years ( $SD = 1.51$ ; range = 18–25) at the first mailer to 29.70 years ( $SD = 0.70$ ; range = 28–33) at the seventh mailer. On average, parents were 21.57 years ( $SD = 2.13$ ; range = 17–26) when they had their first child. The questionnaire included the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977). For participants with children, the same participant also completed the Child Behavior Checklist (CBCL; Achenbach, 1991). Participants who had children at any point during the study period completed the CBCL. At least two CBCL ratings between child ages of 4 and 7 years were completed for biological children of 209 participants. Of the 209 participants, 150 were mothers (72%), who had completed the questionnaires at each time point. We considered the possibility of examining a wider child age range than ages 4 to 7 years. However, the number of cases with data available beyond age 7 years was not sufficient for analysis, and the use of a narrower age range reduces the possibility of developmental or maturational confounds. These 209 parents and their children (101 girls; 48.3%) represent the reference sample for the present study. Most of the parents were Caucasian (91%), were married (69%), and completed high school (68%). Annual household income varied with 13% less than \$10 K, 22% between \$10 K and \$19 K, 22% between \$20 and \$29 K, 28% between \$30 and \$49 K, and 15% more than \$50 K.

### Measures

*CES-D (Radloff, 1977).* The CES-D is a widely used self-report measure of the frequency of 20 depressive symptoms during the past week and has been used in previous studies on the relations between parent depressive symptoms and child behavior problems (e.g., Gross, Shaw, & Moilanen, 2008). Its reliability and validity have received ample support (Joiner, Walker, Pettit, Perez, & Cukrowicz, 2005; Roberts, Lewinsohn, & Seeley, 1991). Internal reliability in the

present sample was good, with coefficient alpha ranging from .91 to .92 across the assessment waves.

**CBCL (Achenbach, 1991).** The CBCL 4-18 is a 113-item measure that was completed for children ages 4 years and older. Items are rated on a 3-point scale, corresponding to whether the behavior is 0 (*not true*), 1 (*somewhat/sometimes true*), or 2 (*very true/often true of the target child*). *T* scores on the Internalizing and Externalizing Problems scales were used as measures of child behavior problems, and these broadband scales have been shown to have excellent reliability and validity (Achenbach, 1991). Among parents with ratings on two or more children that fell within the age range of the present investigation, we included ratings only for the firstborn child to reduce potential biases associated with birth order. Ratings were completed by the mother or the father, but not both. The same parent rated the child at each wave.

### Data Analysis

A measurement model was first fit to test if a latent child behavior problems variable was measurable in the presence of CBCL internalizing and externalizing behavior problems. At each age, scores on the CBCL Internalizing Problems scale and Externalizing Problems scale were used as indicators of a latent child behavior problems variable. Factor loadings of the Externalizing Problems subscale at each age year were set at a value of 1 for the purpose of model identification, and no restriction was made on covariance between the four latent variables (i.e., child behavior problems at age 4, age 5, age 6, and age 7). Model fit was evaluated with the comparative fit index (CFI) and the Tucker–Lewis index (TLI), with values equal to or greater than .90 representing acceptable fit, and the root mean square error of approximation (RMSEA), with values equal to or less than .08 representing acceptable fit (Bentler, 1990; Brown & Cudeck, 1993). In addition to these global fit indices, standardized residual covariances and modification indices were examined to determine model fit. Modifications to the model were made on the basis of model diagnostics and theory, with revised models then being evaluated for fit, again using the global and specific fit indices.

To test the hypothesized reciprocal effects model, we fit a partially latent structural regression model (Kline, 2011) as depicted in Figure 1. The use of a latent child behavior problems variable at each year accounted for measurement error. Only one indicator of parental depressive symptoms was available, so observed scores on the CES-D at each age year were used. A base model was tested modeling the relations between parental

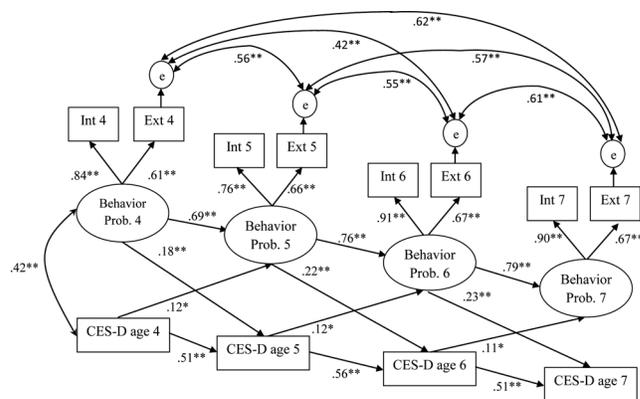


FIGURE 1 Model representing the transactional relationship between parental depressive symptoms and child behavior problems. Note: Path coefficients are standardized. Int = Internalizing Problems scale; Ext = Externalizing Problems scale; Prob. = Problems; CES-D = Center for Epidemiological Studies–Depression Scale. \* $p < .01$ . \*\* $p < .001$ .

depressive symptoms and child behavior problems. The base model consisted of a four-wave, cross-panel design with two sets of paths (see Figure 1). The first set consisted of autoregressive paths *within* each variable (i.e., CES-D and child behavior problems, respectively) from one year to the next (e.g., ages 4–5 years). The second set consisted of reciprocal lagged effects over the course of one year *between* the two variables to examine hypothesized effects of parental depressive symptoms on later child behavior problems and child behavior problems on later parental depressive symptoms.

There is a growing body of literature supporting the moderate stability of psychopathology from the pre-school to school-age periods, including externalizing behavior problems (Keenan et al., 2011; Lahey et al., 2004; Owens & Shaw, 2003) and internalizing behavior problems (Luby et al., 2009; Mian, Wainwright, Briggs-Gowan, & Carter, 2011). On the other hand, research on parental depressive symptoms has been mixed with some suggesting moderate stability (Gross, Shaw, & Moilanen, 2008; Gross et al., 2009; Horwitz et al., 2009), whereas others found more variability in depressive symptoms over time (Gross, Shaw, Moilanen, Dishion, et al., 2008; Luoma et al., 2001). Given some inconsistency in previous findings, we examined a series of equality constraints on the autoregressive and cross-lagged paths to assess the stability of both parental depressive symptoms and child behavior problems in the current sample. Specifically, we tested whether model fit significantly differed when autoregressive paths and cross-lagged paths were freed to vary across age years versus when they were constrained to be equal across the four age years. In the absence of significant differences, the model with equality

constraints is preferred based on parsimony (i.e., higher degrees of freedom). The exogenous age 4 latent child behavior problems variable and the exogenous age 4 parental depressive symptoms variable were allowed to freely correlate. We compared base models in which contemporaneous residual terms between child behavior problems and parental depressive symptoms were allowed to be correlated at all waves to base models with uncorrelated errors. Allowance of correlated residuals at all waves did not lead to significant model improvement, so the more restrictive model was retained based on parsimony.

After fitting the base model, we compared two reduced models. One reduced model had all the paths from child behavior problems to parental depressive symptoms fixed to zero, which indicates conceptually that child behavior problems in one year had no direct effect on parental depressive symptoms in the next year. The other reduced model fixed all the paths from parental depressive symptoms to child behavior problems to zero, which indicates conceptually that parental depressive symptoms at one year had no direct effect on child behavior problems at the next year. Chi-square difference tests were used to determine whether the base model had a significantly better fit than each reduced model. Also, Akaike information criterion difference values ( $\Delta AIC$ ) were examined in the model selection process, with values equal to or greater than 4 indicating models that have considerably less support than the best approximating model (Burnham & Anderson, 2004). All models were estimated using the statistical program Mplus 6.1 (Muthén & Muthén, 1998–2010).

## RESULTS

### Preliminary Analyses

**Univariate analyses.** Observed means and standard deviations on the outcome variables at each age are presented in Table 1. Mean child behavior problem scores

and parental depressive symptom scores were consistently in the subclinical range. At age 7 years, mothers reported significantly higher externalizing behavior problems and depressive symptoms than fathers. No other significant mean differences between mothers and fathers and no significant differences in internalizing and externalizing behavior problems between boys and girls were identified at any other ages. As displayed in Table 2, correlations between CBCL behavior problem and CES-D scores across all ages ranged from .13 to .48. For CBCL internalizing behavior problem and CES-D scores, 15 of the 16 correlations were statistically significant ( $p < .05$ ), and for CBCL externalizing behavior problem and CES-D scores, 14 of 16 correlations were statistically significant ( $p < .05$ ). Consistent with findings from the national normative sample for the CBCL (Achenbach, 1991), the cross-sectional correlations between CBCL internalizing scores and CBCL externalizing scores at each age ranged from .46 to .64.

**Evaluation of nonnormality.** The distributions revealed some skewness for CES-D at age 4 years, so maximum likelihood with robust standard errors (MLR) was used to examine the model. Data were also analyzed using standard maximum likelihood procedures, and there were no differences in conclusions as compared to the MLR procedures. Subsequent chi-square difference tests were conducted using the Satorra–Bentler method because MLR procedures were used (Satorra & Bentler, 2001).

**Outlier analyses.** Prior to analysis, the data were evaluated for multivariate outliers at each time point for all continuous measures included in the analyses by examining leverage indices for each individual. We defined an outlier as a leverage score 4 times greater than the mean leverage value. Standardized  $df$  betas were also examined for each individual and each predictor (as well as the intercept) in the linear equations. An

TABLE 1  
Observed Means and Standard Deviations on Measured Variables

Child Age	n	CBCL Internalizing		CBCL Externalizing		CES-D	
		M (SD)	Range	M (SD)	Range	M (SD)	Range
4	143	43.99 (8.42)	33–68	48.53 (8.75)	30–71	12.19 (10.28)	0–57
5	156	45.67 (8.23)	33–72	49.02 (9.07)	30–76	12.63 (10.45)	0–49
6	157	45.87 (8.29)	33–82	48.70 (9.86)	30–74	12.69 (9.40)	0–53
7	124	47.49 (9.92)	33–79	48.71 (10.63) <sup>a</sup>	30–82	12.42 (10.94) <sup>b</sup>	0–53

Note: N = 209. CBCL Internalizing = Child Behavior Checklist Internalizing Behavior Problems T score; CBCL Externalizing = Child Behavior Checklist Externalizing Behavior Problems T score; CES-D = Center for Epidemiological Studies–Depression Scale.

<sup>a</sup>Mothers reported significantly more externalizing behavior problems than fathers ( $p < .01$ ).

<sup>b</sup>Mothers reported significantly more depressive symptoms than fathers ( $p < .05$ ).

TABLE 2  
Correlations Between Measured Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1 CBCL Int (4 years)												
2 CBCL Ext (4 years)	.531**											
3 CES-D (4 years)	.336**	.309**										
4 CBCL Int (5 years)	.483**	.303**	.360**									
5 CBCL Ext (5 years)	.378**	.652**	.240*	.455**								
6 CES-D (5 years)	.339**	.183	.551**	.209**	.287**							
7 CBCL Int (6 years)	.415**	.357**	.342**	.539**	.421**	.297**						
8 CBCL Ext (6 years)	.323**	.510**	.300**	.279**	.656**	.278**	.610**					
9 CES-D (6 years)	.319**	.235*	.596**	.175	.243**	.605**	.274**	.320**				
10 CBCL Int (7 years)	.426**	.433**	.365**	.549**	.556**	.377**	.657**	.479**	.265**			
11 CBCL Ext (7 years)	.324**	.673**	.322**	.390**	.674**	.287**	.455**	.705**	.257*	.639**		
12 CES-D (7 years)	.466**	.390**	.497**	.435**	.347**	.512**	.377**	.287**	.540**	.484**	.377**	

Note: CBCL Int = Child Behavior Checklist Internalizing Behavior Problems *T* score; CBCL Ext = Child Behavior Checklist Externalizing Behavior Problems *T* score; CES-D = Center for Epidemiological Studies–Depression Scale.

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

TABLE 3  
Indicators of Model Fit

Model	$\chi^2$	CFI	TLI	RMSEA	AIC	BIC
Base	46.29	1.00	.99	.005	12062.83	12209.89
Reduced: No C → P	63.44	.97	.96	.041	12080.51	12224.23
Reduced: No P → C	52.62	.99	.98	.024	12067.84	12211.56

Note: Reported chi-square values are from robust estimation procedures and were not used for chi-square difference testing. CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; AIC = Akaike information criterion; BIC = Bayesian information criterion; No C → P = cross-lagged paths from child behavior problems to parent depressive symptoms were removed; No P → C = cross-lagged paths from parent depressive symptoms to child behavior problems were removed.

outlier was defined as any case with an absolute standardized *df* beta larger than 1.0. A total of 22 outliers (11%) were detected using these criteria. All analyses were conducted with and without the outliers, and conclusions in the two analyses were comparable. The data presented next included the outliers.

**Missing data.** The extent of missing data ranged from 24.9 to 41.1% at each age (Table 1), and all participants had complete data during at least two of the four ages. We created separate variables representing missing data at each year for each participant, and then we examined the associations between these variables and all other study variables. Only one of 40 possible associations was statistically significant: missingness at age 5 years was associated with parent gender,  $\chi^2(1) = 6.18$ ,  $p < .05$ , such that the rate of missing data was higher for fathers than mothers. There were no significant associations between missing data and scores on the CES-D or CBCL. Given only one of 40 possible associations was significant, there was no strong evidence for bias. Therefore, we adopted a missing at random assumption and used full information maximum likelihood estimation to accommodate missing data.

### Measurement Model

The initial measurement model of child behavior problems provided an unacceptable fit to the data,  $\chi^2(14) = 86.81$ ,  $p < .001$ , CFI = .84, RMSEA = .16. Inspection of model diagnostics revealed that the primary source of poor fit was the assumption of zero correlations between the residuals of externalizing behavior problems at each age. To address the poor model fit, we allowed the residuals of externalizing behavior problems at each age year to correlate freely. Conceptually, these correlations represent the presence of a construct (or constructs) outside of the model that accounts for shared variance between externalizing behaviors at each age year, beyond the variance accounted for by the latent child behavior problems factor. The revised measurement model fit the data well,  $\chi^2(8) = 7.11$ ,  $p = .52$ , CFI = 1.00, RMSEA < .001, and was therefore retained for the reciprocal effects structural model.

### Reciprocal Effects Model

A partially latent structural base model with four waves (see Figure 1) was examined to test the relations between

parental depressive symptoms and child behavior problems. Placing or removing equality constraints on the autoregressive paths across age years and the cross-lagged paths across age years did not significantly impact model fit, all  $\Delta\chi^2$ 's < 4.5, all  $p$ 's > .20. Therefore, we retained the model in which the autoregressive paths and the cross-lagged paths were constrained to equality across waves. The model provided a good fit to the data (see Table 3). All of the direct paths within the model were statistically significant. Similarly, and consistent with a reciprocal effects model, all cross-lagged paths were statistically significant. As shown in Figure 1, higher levels of parental depressive symptoms at one year were associated with higher levels of child behavior problems at the next year, and higher levels of child behavior problems at one year were associated with higher levels of parental depressive symptoms at the next year. Specifically, for every 1 *SD* increase in parental depressive symptoms at any given year, child behavior problems at the following year increased by approximately .12 *SD*, and for every 1 *SD* increase in child behavior problems at any given year, parental depressive symptoms at the following year increased by approximately .20 *SD*. The effect sizes of these paths were in the small to moderate range, and the residual variance for the endogenous variables ranged from .55 to .63 for the CES-D and from .30 to .44 for child behavior problems across age years.

Two reduced models were also evaluated in comparison to the base model. For the first reduced model, all of the paths from child behavior problems to parental depressive symptoms were constrained to zero. A chi-square difference test indicated that the base model provided a significantly better fit than the reduced model,  $\Delta\chi^2(1) = 19.34$ ,  $p < .001$ . Similarly, larger AIC ( $\Delta\text{AIC} = 17.68$ ) and BIC values for the reduced model (Table 3) supported the retention of the base model. For the second reduced model, all of the paths from parental depressive symptoms to child behavior problems were constrained to zero. A chi-square difference test indicated that the base model provided a significantly better fit than the reduced model,  $\Delta\chi^2(1) = 8.02$ ,  $p < .01$ . Once again, larger AIC ( $\Delta\text{AIC} = 5.01$ ) and BIC values for the reduced model (Table 3) supported the retention of the base model.

Although there was an insufficient number of fathers to conduct formal tests of parental gender as a moderator of the paths between depressive symptoms and child behavior problems, we conducted analyses among mothers only and found similar path coefficients in all instances. Thus, the nature of the findings previously presented held when analyses were restricted to mothers. To examine child gender as a moderator, multiple group models with a series of equality constraints on cross-lagged paths were conducted. No support for child

gender moderation was found. That is, the most parsimonious model constrained the three lagged paths from parental depressive symptoms to child behavior and the three lagged paths from child behavior to parental depressive symptoms to equality across child gender.

## DISCUSSION

The current study provides support for a transactional model depicting a series of bidirectional relationships between parental depressive symptoms and child internalizing and externalizing behavior problems from ages 4 to 7 years. To our knowledge, this is the first study examining the transactional relationship between parental depressive symptoms and child behavior problems to include both mothers and fathers, as well as internalizing and externalizing behavior problems. In addition, the sample in the current study includes a more representative sample than previous research on this transactional process that largely included children from high-risk families.

Specifically, results in the current study are consistent with a model that suggests higher parental depressive symptoms at each age contributes to higher child behavior problems at the following year and vice versa, above and beyond the autoregressive effect of the variable at time  $t$  as a function of that same variable measured at time  $t-1$ . These results add to a relatively small literature on the reciprocal and proximal associations between parental depressive symptoms and child behavior problems. To our knowledge, this is the first study to empirically examine the reciprocal relations between parental depressive symptoms and child internalizing problems over several years in young children's lives.

The support for equality constraints on all paths suggests the strength of the bidirectional influence between parental depressive symptoms and child behavior problems does not change during the developmental period between ages 4 and 7 years. These findings are consistent with previous research for externalizing (Keenan et al., 2011; Lahey et al., 2004; Owens & Shaw, 2003) and internalizing (Luby et al., 2009; Mian et al., 2011) behavior problems, as well as some findings on parental depressive symptoms (Gross, Shaw, & Moilanen, 2008; Gross et al., 2009; Horwitz et al., 2009). This age range corresponds to the kindergarten to second-grade period, so the extent to which parental depressive symptoms lead to higher child behavior problems may interfere with the child's successful transition into school and affect the child's educational trajectory. Child behavior problems at school may, in turn, lead to higher parental depressive symptoms, particularly if teachers inform the child's parents about any difficulties at school (it should

be noted that we were unable to test this hypothesis in the present study given the lack of teacher ratings). Previous research has demonstrated that maternal depression during early childhood predicted later children's intellectual performance (Hay et al., 2011; Sharp et al., 1995), but further research would need to examine whether child behavior problems mediate this relationship.

Overall, the transactional relationship between parental depressive symptoms and child behavior problems was consistent with previous research demonstrating the effect of maternal depression on both child behavior problems (Goodman et al., 2011; Kouros & Garber, 2010; Pemberton et al., 2010). Specifically, the cross-lagged effect of parental depressive symptoms on child externalizing behavior problems was identical with the Gross, Shaw, and Moilanen (2008) study (.11) but about half the size of the lagged effect of parental depressive symptoms on child internalizing behavior problems (.21). The current study extends these findings to an earlier age range and a model in which the transactional relationships were measured consecutively each year from ages 4 to 7 years, in contrast to Gross, Shaw, and Moilanen (2008) measuring the relationships between ages 5 and 6, 6 and 8, and 8 and 10 years. In addition, the current study used the more inclusive broad-band scales on the CBCL (i.e., Internalizing and Externalizing) as indicators of a latent factor of child behavior problems rather than the specific Aggressive Behavior subscale used in the Gross, Shaw, and Moilanen (2008) study. The use of a latent factor with multiple indicators also accounted for measurement error in child behavior problems. Taken together, the results of both studies provide support for the transactional relationship between parental depressive symptoms and child internalizing and externalizing behavior problems.

The child moderation analyses suggested that the transactional relationship during this age range was not different for boys and girls. Only boys were included in the Gross, Shaw, and Moilanen (2008) study, so this was the first study to examine child gender as a moderator in the transactional relationship between parental depressive symptoms and child behavior problems. These findings are consistent with prior cross-sectional research conducted by Cummings and colleagues (2005) indicating that child gender did not moderate the effect of parental depressive symptoms on child internalizing and externalizing behavior problems. In light of the very small body of empirical research in this area, however, we encourage future research on bidirectional models to examine child gender as a potential moderator.

The current study has some limitations that are important to consider. First, parental depressive symptoms and child behavior problems were rated by the same individual using self-report and parent-report

measures, respectively, suggesting the correlations between these constructs may be inflated as a result of shared method variance. Larger correlations due to shared method variance may be attributed to a propensity to report more negative events and behaviors, as well as social desirability (Youngstrom, Loeber, & Stouthamer-Loeber, 2000). Given the importance of using multimethod assessment, the inclusion of reports from other caregivers (e.g., teachers) and more objective measures (e.g., observations) would have enhanced confidence in study findings. Unfortunately, teacher report of child behavior was not available (many children younger than 5 years of age may not have been in school), and the children were too young to provide valid self-report of their behavior. Therefore, we were unable to address the important limitation of shared method variance in the current study.

In addition to shared method variance, some research suggests parents' current mood state may bias ratings of their child's behavior problems (e.g., the depression-distortion effect; Gartstein, Bridgett, Dishion, & Kaufman, 2009). On the other hand, Conrad and Hammen (1989) found that parents with depression are actually more accurate in their report of their child's behavior. In addition, the amount of variance attributed to bias from parental depressive symptoms has been shown to be relatively small. For example, using structural equation modeling with mother, father, and child report of behavior problems in a community sample, parental distress only accounted for between 1 and 3% of the variance in parent report of child behavior problems (Sawyer, Streiner, & Baghurst, 1998). In a clinical sample, parental depressive symptoms accounted for 11% of the variance for child internalizing problems and only 2% for externalizing problems (Kroes, Veerman, & De Bruyn, 2003). Therefore, the extent to which depressive symptoms bias parents' report of child behavior is relatively low, especially for internalizing behavior problems, and suggests that our findings are not likely to be unduly influenced by this potential bias.

The sample in the current study was also relatively homogeneous with most participants from Caucasian and middle socioeconomic backgrounds. Therefore, it would be important to examine these associations in more diverse samples as the processes through which parental depression affects child behavior problems differs among families from different ethnic and cultural backgrounds (Pachter, Auinger, Palmer, & Weitzman, 2006). Participants in the Oregon Adolescent Depression Project were recruited from high schools in an attempt to obtain a representative sample. On average, the participants had their first child relatively young, which has been associated with higher symptoms of depression (Mirowsky & Ross, 2002). However, the average CBCL and CES-D scores were not in the

clinical range, which limits generalizability to children and parents with clinically significant problems. It should be noted that the sampling strategy at T3, in which parents with a history of psychopathology were oversampled, may have resulted in higher levels of parent depressive symptoms and child behavior problems than if the original random sample had been maintained throughout the study. In addition, despite the uniqueness of the inclusion of fathers in this study, the low number of fathers prevented formal moderation testing. However, differences between mothers' and fathers' reports of their children's behavior in this sample were minimal (i.e., only externalizing behavior problems at age 7 years), and the path coefficients obtained among mothers were similar to those for the combined sample of mothers and fathers.

In the current longitudinal study, missing data occurred at each year, reaching as high as 41% at age 7. There was no evidence for bias due to missing data, and full information maximum likelihood generally produces little bias and high efficiency in the estimation of missing data. Nevertheless, these findings should be replicated in other studies with more complete data. Although the fit indices suggested that our hypothesized model fit the data well, it is possible that other structural models may fit the data equally well (i.e., the problem of equivalent models). In addition, only firstborn children were included, which introduces a potential bias of birth order. Finally, the failure to incorporate other theoretically relevant variables, such as parent-child interactions (e.g., number of times a parent praises a child during play) in our model may have biased parameter estimates, and future research should incorporate these variables in other transactional models to better account for measurement error.

Despite the limitations, there are several strengths that enhance confidence in the study findings. First, we used multivariate modeling strategies in the form of structural equation modeling, which allowed us to consider a diverse set of alternative model forms. Second, we included both mothers and fathers increasing the generalizability of the study findings. Unfortunately, there were not enough fathers at each time wave to examine parental gender as a moderator, and this important question should be addressed in future research. Finally, the study was a longitudinal design that allowed us to model the transactional effect over 4 consecutive years in early childhood in a consistent and thorough manner.

#### Implications for Research, Policy, and Practice

The current findings are consistent with the existing, albeit small, body of research and suggest there is a reciprocal relationship between parental depressive

symptoms and child behavior problems from ages 4 to 7 years. Support for this bidirectional relationship may help to inform the development of early childhood preventive intervention programs (Kersten-Alvarez, Hosman, Riksen-Walraven, Van Doesum, & Hoefnagels, 2010) and is consistent with efforts to include a treatment of maternal depression following an intensive treatment for children with attention deficit/hyperactivity disorder (Chronis, Gamble, Roberts, & Pelham, 2006). There is increasing evidence supporting preventive intervention programs for adult depression (Muñoz, Le, Clark, Barrera, & Torres, 2009) and for early childhood problems (Riley et al., 2008). In addition, the reciprocal nature of the relationship between parental depression and child behavior problems suggests that intervening in one domain may possibly lead to improvements in both domains (Garber, Ciesla, McCauley, Diamond, & Schloedt, 2011), and findings from the Family Check-Up intervention indicated reductions in maternal depression mediated improvements in child behavior problems (Shaw, Connell, Dishion, Wilson, & Gardner, 2009). Future research should continue to disentangle the relationship between parental depressive symptoms and child behavior problems with a specific focus on potential mechanisms that can help in the development and refinement of prevention and treatment programs.

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