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ORIGINAL PAPER

Bidirectional Effects of Positive Affect, Warmth, and Interactions Between Mothers With and Without Symptoms of Depression and Their Toddlers

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Abstract Maternal depression has negative implications for parenting and child outcomes, but it is also important to understand the daily transactional interactions that occur between mothers varying in symptoms of depression and their children. The current study aimed to examine immediate bidirectional effects between maternal warmth and positive affect and toddler affect in a sample of mothers varying in symptoms of depression. Ninety-one mothers and their 24-month-old toddlers completed a laboratory free-play/clean-up task. Mothers rated their symptoms of depression using the CES-D, and maternal warmth and positive affect and toddler positive and negative affect were observationally coded from a free-play and clean-up laboratory task. Sequential analyses indicated that mothers with no or mild symptoms of depression exhibited mutual positive affect with their children, but mothers with more severe symptoms of depression did not. Mothers with higher symptoms of depression displayed a decrease in warmth concurrent with toddlers' positive affect. Further, unlike dyads in which mothers had higher symptoms of depression, dyads of mothers with lower symptoms appeared to exhibit some covariation in positive affect across the episode. These results provide evidence that even in non-clinical samples, affective manifestations of mothers' subthreshold levels of depression may have negative immediate effects on toddlers' emotions, and that mothers without symptoms of depression may have more reciprocal affective exchanges with their toddlers.

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Introduction

Depression is a common psychological problem among mothers, with 17–24 % of mothers of young children experiencing at least some symptoms of depression (McLennan et al. 2001). Maternal depression is linked to a negative cognitive style which may influence the quality of the mother's parenting experience, including her feelings of competence as a mother, her enjoyment of her parental role, and her perceptions of her child (Downey and Coyne 1990; Goodman 2007). These negative feelings may hinder the degree to which mothers with even subthreshold levels of depression can effectively parent, leading to negative outcomes for the child. Additionally, depression is distinguished from other internalizing disorders (e.g., anxiety) by reduced expressions of positive affect (Clark and Watson 1991), which may contribute to the quality of mother–child interactions. However, few studies have examined the role of positive affect in particular when exploring interactions between mothers with symptoms of depression and their children, making the immediate effects of maternal positive affect and warmth on toddler affect unclear. Moreover, even fewer studies have examined potential bidirectional relations between toddlers and mothers who vary in symptom levels.

Previous research, which has typically focused on clinical levels of depression, suggests that maternal depression has negative implications for child emotional development, including higher levels of internalizing and externalizing problems (e.g., Goodman et al. 2011), as well as higher levels of negative affect and lower levels of positive affect

(e.g., Beardslee et al. 2011). Current theory suggests that maternal depression impairs parenting by compromising maternal cognitions, behaviors, and affect, which in turn contribute to parental neglect of children's social-emotional needs and increase risk for children's development of similar negative behavioral, cognitive, and affective styles (Goodman and Gotlib 1999). Current research suggests that mothers with elevated symptoms of depression are more likely to exhibit less responsiveness, attention, and warmth toward their children (Cummings and Davies 1994; Gelfand and Teti 1990) than non-depressed mothers. This overall lack of maternal warmth can manifest in a variety of behaviors, including decreased positive verbalizations (e.g., laughing, positive tone of voice), physical affection (e.g., hugging), and positive facial expressions (e.g., smiling). Such findings suggest that the symptoms of depression may inhibit mothers' abilities to exhibit levels of warmth and positive affective signals thought to be important for young children's emotional development (Cummings and Davies 1994). However, given that much of this research has been conducted using clinically depressed mothers, it remains unclear how these processes may operate in subclinical populations.

One way to conceptualize the parenting difficulties related to the symptoms of depression is by examining their positive and negative affect (Lovejoy et al. 2000). Using this framework, mothers experiencing depression can be typified by two primary mood states: high negative affect or low positive affect. Mothers characterized primarily by high negative affect (e.g., anger, irritability, distress) can be expected to engage in more hostile interactions with their children, whereas mothers characterized primarily by low positive affect (and associated lack of interest or energy) can be expected to be less responsive, involved, or warm with their children. Many studies have investigated the outcomes associated with high negative maternal affect (e.g., Cox et al. 1987; Field et al. 1990). Fewer studies have examined the specific contribution of low positive maternal affect, but the research that does exist suggests a relation between maternal depression and low positive affect. For example, during home observations of mothers and their children, Hops et al. (1987) observed that mothers with elevated symptoms of depression exhibited more sad affect and less positive affect. Additionally, during play interactions, Field et al. (1990) found that depressed mothers expressed less positive affect than mothers without depression, and more recent research similarly suggests that depressed mothers are less likely to display positive affect and sensitivity with their infants (Field 2008).

Research by Field et al. (1990) also suggests that maternal affective displays may have significant immediate effects, as even in infancy children may mimic the affect of depressed mothers. Further research has found that infants of mothers exhibiting depressed mood are more withdrawn and exhibit fewer positive facial expressions and vocalizations (Field 2008; Weinberg and Tronick 1998), appear distressed more often, and respond less reciprocally to their mothers' attempts to elicit positive behavior (Zekoski et al. 1987). Additionally, Field et al. (2005) found that infants of mothers with elevated symptoms of depression show fewer increases in negativity during non-reciprocal interactions with their mothers. The authors suggested that this may be because these infants are more accustomed to such interactions their mothers. Taken together, it appears that even in infancy children recognize their mothers' moods and react to them, and that the symptoms of depression limit mothers' effectiveness in evoking more positive states in their children. Conversely, studies utilizing samples of non-depressed mothers suggest that mutually positive and responsive interactions between mothers and their young children foster children's compliance and internalization of maternal values (Kochanska 1997; Kochanska et al. 2008). However, more research is needed to elucidate how these patterns of maternal behavior and affect may influence children's emotional development in subclinical samples of mothers varying in symptoms of depression.

One way to understand what happens between maternal behavior and children's outcomes is to look more closely at the dyadic interactions between mothers and children that occur on a day-to-day basis. Although home observations may provide one example of such interactions (e.g., Hops et al. 1987), tasks in the laboratory can also serve as reasonable proxies for similar interactions that occur between parents and children. For example, several studies have utilized a free-play and clean-up task as an index of how mothers and children interact in a relatively unstructured setting, how mothers elicit compliance from their children, and how children respond to mothers' commands (e.g., Dawson et al. 2003). Research employing such tasks has shown that depressed mothers and their infants match negative behavior states (e.g., disengaged/look away) more often and positive states (e.g., play) less often than non-depressed dyads (e.g., Field et al. 1990). However, because subthreshold levels of depression are more common among mothers than clinical depression (e.g., McLennan et al. 2001), it is important to explore these dyadic processes in subclinical, low-risk populations. Some research suggests that similar processes occur in mothers with subthreshold levels of depression and may have negative implications for toddlers' socioemotional development, including higher levels of internalizing and externalizing symptoms and difficulties in emotion regulation (e.g., Hummel and Kiel 2015; West and Newman 2003). However, few studies have investigated the immediate, transactional behavioral and affective responses of these mothers and their toddlers during dyadic interactions. As an exception, Skotheim et al.

(2013) found that 3-month-old infants of sub-clinically depressed mothers demonstrated decreased affective sensitivity to maternal social contingency, suggesting that even subclinical symptoms of depression may influence children's responses to their mothers. However, this study did not examine mothers' behavior with their infants.

Although existing research supports that interactions between depressed mothers and their toddlers may be non-optimal, few studies have examined the immediate effects of maternal warmth and positive affect and toddler affect, and compared these interactions in mothers both with and without symptoms of depression. Thus, the current study aimed to extend the research on maternal depression by examining how toddlers of mothers with varying levels of depression respond to maternal warmth and positive affect associated with depression, as well as how these mothers respond to their toddlers' affect. Based on the previous research indicating that mothers with elevated symptoms of depression exhibit lower warmth, lower positive affect, and respond less positively to their toddlers than non-depressed mothers (Cummings and Davies 1994; Field 2008; Field et al. 1990), it is hypothesized that mothers with no/low symptoms of depression will exhibit more positive interactions with their toddlers, such that they will increase in positive affect and warmth contingent with their toddlers' positive affect, their toddlers will increase in positive affect after their mothers' positive expressions, and that the overall interaction will be more mutually positive (i.e., mothers and toddlers will exhibit concurrent positive affect). For mothers with moderate/high symptoms of depression, it is hypothesized that mothers will respond less reciprocally to their toddlers' positive affect, that toddlers will respond less reciprocally to their mothers' positive expressions, and that the overall interaction will be not be characterized by the same mutual positivity.

Method

Participants

As part of a larger study on parent–child interactions and toddler temperament, 91 toddlers and their mothers participated in a laboratory visit and questionnaire completion when toddlers were approximately 24 months old ($M = 23.93$ months, SD = .70 months). Mothers were recruited through the mail according to local publish birth records ($n = 82$) and in person at local meetings of the Woman, Infants, and Children (WIC) program ($n = 9$). Children were 85 % European American, 5 % African American, 8 % Asian American, 1 % biracial, and 1 % "other." Mothers ranged in years of education from 11 to 20+ years ($M = 16.35$ years, SD = 2.36 years), with approximately 70 % reporting a college education or above. Families' gross annual incomes ranged from <$16,000 to more than $60,000, with the majority reporting at least $41,000 (Median = $51,000–$60,000).

Procedure

Mothers who expressed interest in joining the study (either via a postcard returned through mail or by signing up at a WIC meeting) were contacted by a laboratory staff member and mailed a packet containing a consent form and questionnaires. At the laboratory, the experimenter told the mother that her toddler would be participating in a variety of activities, including a free-play and clean-up task. These visits were videotaped for observational coding by trained coders.

The experimenter led the mother and child into a large room with several age-appropriate toys. She stated to them, "These toys are here for both of you to play with. You can play with them however you like, and I will be back in a few minutes." She then left the room and allowed the mother and child to play for 3 min. After that time, the experimenter knocked and entered the room with a large tub. She stated, "Wow, it looks like you had a lot of fun in here! Now I'd like (child's name) to put the toys away in this bin so we can get ready for the next game. (Mom's name), you can do whatever you would normally do to help (child's name) clean up. I'll let you both work on that and I'll be back in a few minutes." The clean-up portion lasted until the toys were cleaned up, or a maximum of 5 min.

Measures

Maternal Symptoms of Depression

Mothers reported on their symptoms of depression using the Center for Epidemiological Studies-Depression scale (CES-D; Radloff 1977). This 20-item measure assesses symptoms of depression in the general population. Mothers rated how often they experienced various symptoms of depression during the past week (e.g., "I felt sad") using a 4-point scale ranging from 0 (*rarely to none of the time*) to 3 (*most or all of the time*). A sum of the 20 items ($\alpha = .80$) yielded an overall depression symptom score. In addition to providing a dimensional measure of symptoms of depression, this sum was used to categorize mothers into two categories: if mothers received a sum score of 15 or above (indicating the presence of clinically relevant levels of symptoms of depression; Berkman et al. 1986), they were categorized as having moderate/high symptoms of depression ($n = 20$); if mothers received a score below 15 they were categorized as no/low symptoms of depression ($n = 71$). Because the current study focuses on the

presence of at least mild symptoms of depression and because severe symptoms were uncommon in our sample ($n = 2$), we used two categories rather than the three categories (mild, moderate, severe) according to the typical CES-D cut-offs.

Maternal Warmth and Positive Affect

Maternal behavior and affect coding proceeded according to procedures developed by Gaertner et al. (2008). During the free-play and clean-up episodes, maternal behavior was coded for warmth and positive affect. These behaviors and expressions were rated during 10-second intervals. Warmth (e.g., closeness, friendliness, encouragement, physical affection) was coded on a 5-point scale, from 1 (*none,* e.g., parent ignores child most of the time) to 5 (*high, parent is engaged with child most of the time*). Positive affect (PA) was coded on a 4-point scale ranging from 1 (*no evidence of PA)* to 4 (*intense PA,* e.g., intense smile or laugh). Coders received 20 h of training from a master coder, with whom they established minimum reliability (interclass correlation [ICC] = .80). Trained coders maintained reliability with the master coder, assessed on approximately 20 % of cases, throughout coding (both ICCs = .84).

Toddler Affect

During the free-play and clean-up episodes, child positive and negative affect were coded using a scale adapted from Crockenberg and Leerkes (2004). Positive affect (PA) was rated using a 4-point scale, ranging from 0 (*no PA*) to 3 (*high PA*, e.g., laughing or intense smiling behaviors). Negative affect (NA) was rated using a similar 4-point scale, ranging from 0 (*no NA*) to 3 (*high NA*, e.g., intense sobbing or screaming). PA and NA were scored independently, such that a toddler could express both PA and NA within the same interval. Coders received 20 h of training from a master coder, with whom they established minimum reliability (interclass correlation [ICC] = .80). Trained coders maintained reliability with the master coder, assessed on approximately 20 % of cases, throughout coding (ICCs = .86 and .85, respectively).

Analysis Strategy

Examination of the frequency of toddler affective displays revealed too few instances of NA (only 21 of the 1837 observations indicated the presence of any NA) to analyze. Although previous studies have found that the clean-up task can elicit toddler negative affect (e.g., defiance; Stifter and Wiggins 2004), it is possible that characteristics of the current sample (e.g., well-educated, middle-class, low psychopathology) contributed to the lower occurrence of NA. Because of this low number, Chi squares could not be computed for NA because a number of cells would have zero or near-zero frequencies. Therefore, analyses focused solely on toddler PA. First, we examined differences between mothers with no/low symptoms of depression and those with moderate/high symptoms in terms of the latency, frequency, and duration of their own PA and warmth as well as their toddlers' PA. We also examined group differences in the order of maternal and toddler displays.

Next, we examined group differences in the contingencies between concurrent toddler PA and maternal PA and warmth. To do so, mother and toddler affect and behavior scores were condensed to low (0, 1) and high (2, 3) values. Consistent with recommendations (Bakeman and Gottman 1997) and existing literature (e.g., Crockenberg and Leerkes 2004), contingency analyses were then used to determine the co-occurrence between maternal PA/warmth and toddler PA responses, as well as the co-occurrence between toddler PA and maternal PA and warmth responses. For these analyses, change variables were created for maternal PA and warmth and toddler PA using the full scales (0–3) by calculating the change from one 10-second interval to the following interval (i.e., by examining the difference in each variable between the two intervals). These change variables were categorized as increase, no change, or decrease based on procedures used in previous literature (e.g., Buss and Goldsmith 1998).

Given a significant Chi square value for the contingency table for a maternal variable and toddler variable, standardized residuals of individual cells were examined to determine where co-occurrences deviated from chance. As *Z*-scores, these standardized residuals indicate a significant difference between observed and expected frequencies when values are outside of 95 % of typically expected frequencies or outside 2 standard deviations from the mean ($Z = \pm 1.96$).

Finally, in order to contextualize the previous analyses, we used multilevel modeling to assess the time courses of maternal PA and warmth and toddler PA across the free-play/clean-up task and whether maternal symptoms of depression influenced them. We examined the interaction between maternal symptoms of depression (measured both categorically and continuously) and time in relation to scores progressing across the intervals of the episode.

Results

Mothers with no/low symptoms of depression and those with moderate/high symptoms did not vary on their latency (i.e., the number of seconds until behavior was exhibited) to express PA (8.66 and 6.80 s, respectively; t [89] = 0.55,

ns), nor did toddlers vary on their latency to express PA (15.79 and 20.80 s, respectively; t [88] = −0.67, *ns*). Additionally, when comparing latency to express PA between mothers and toddlers, both mothers with moderate/high symptoms of depression (t[19] = −2.41, p = .03) and with no/low symptoms of depression (t[69] = −2.04, p = .04) tended to express PA before their toddlers. Taken together, these results suggest that there were not significant differences between groups in how long it too mothers and toddlers to express PA. For mothers with no/low symptoms of depression, maternal PA latency and toddler PA latency were positively correlated (r = .31, p = .01), but mother and toddler latency were not significantly associated for mothers with moderate/high symptoms of depression (r = .24, *ns*), possibly due to low power. However, a Fisher r-to-z transformation, which uses a z-score to examine the difference between two correlation coefficients (Cohen and Cohen 1983), indicated that these correlations were not significantly different from one another (Z = 0.25, *ns*).

Overall, maternal warmth and PA expressions were positively correlated (r = .48, p < .05). Toddler PA was also correlated with maternal PA (r = .17, p < .05), but there was no significant bivariate relation between toddler PA and maternal warmth. Additionally, mothers with no/low symptoms of depression and those with moderate/high symptoms displayed similar levels of PA (M = 2.32 and 2.42, respectively) and warmth (M = 3.42 and 3.38, respectively). Children of mothers with no/low symptoms of depression and those with moderate/high symptoms displayed similar levels of PA (M = 0.74 and 0.81, respectively). Independent samples t tests revealed no significant differences in maternal PA and warmth and child PA between mothers in the two groups.

Results from contingency analyses indicated that mothers with no/low symptoms of depression were more likely than would expected by chance to experience co-occurring high PA with their toddlers' high PA (Table 1; χ^2 = 47.76, df = 1, p < .01) and were less likely to experience low PA concurrent with toddlers' high PA. Conversely, mothers with moderate/high symptoms of depression did not exhibit co-occurring PA with their toddlers' PA (χ^2 = .17, *ns*). Mothers with no/low symptoms of depression did not exhibit warmth concurrent with toddlers' PA (χ^2 = .17, *ns*).

For mothers with no/low symptoms of depression, change in toddler PA was not distributed by chance across maternal PA expression (Table 2; χ^2 = 21.45, df = 2, p < .01). More specifically, toddlers were less likely to decrease in PA when mothers exhibited low PA and were more likely to decrease in PA and less likely to exhibit no change in PA when mothers exhibited high PA. Given that toddlers and mothers tended to exhibit concurrent high PA in this group, this may reflect that these dyads may be exhibiting more variation in their PA expressions, and we may be catching the decreases of these variations. There were no significant changes in toddler PA in response to moderate/high depressive mothers' PA expression (χ^2 = 1.80, df = 2, *ns*). There were no significant changes in toddler PA in response to warmth from mothers with no/low symptoms of depression (χ^2 = 0.53, df = 2, *ns*).

For mothers with no/low symptoms of depression, change in maternal PA was not distributed by chance across toddler PA expression (Table 3; χ^2 = 11.30, df = 2, p < .01). More specifically, these mothers were more likely to decrease in PA in response to their toddlers' PA (standardized residual = 2.80). There were no significant changes in PA for mothers with moderate/high symptoms of depression in response to toddler PA (χ^2 = 2.00, df = 2, *ns*). There were no significant changes in warmth in response to toddler PA for mothers in either group.

In order to better understand the time course of maternal PA, maternal warmth, and toddler PA, we performed multilevel analyses to model change in scores across the free-play/clean-up episode. Multilevel modeling (MLM) is a regression-based statistical technique that models the nesting of repeated observations (such as our repeated assessments of PA and warmth) within a higher-order grouping variable (in our case, participant) (Raudenbush and Bryk 2002). It accounts for the non-independence of error terms of nested observations, which would violate assumptions of typical regression parameters derived through Ordinary Least Squares estimation. Relevant to our purposes, MLM can be used to perform growth modeling, which yields information about patterns of change over time. Although these analyses do not assess effects between maternal PA and warmth, on the one hand, and toddler PA, on the other, as in the previous section, they do contextualize the contingency analyses to provide general trends in these constructs across the episode and whether maternal symptoms of depression influence them.

We analyzed three models with maternal PA, maternal warmth, and toddler PA, respectively, as dependent variables. Individual interval scores were nested within participants, yielding two-level models with interval scores at Level 1 and participant at Level 2. For these analyses, scores maintained original values (they were not dichotomized). From models with no predictors, intraclass correlation coefficients (ICCs) were calculated to determine the proportion of variance in a given score (maternal PA, maternal warmth, or toddler PA) occurring between participants, with higher numbers indicating more within-participant similarity in scores (Heck et al. 2014). In other words, higher ICCs indicate that scores are more similar within a participant than would be expected across two

Table 1 Co-occurring maternal behavior/affect and toddler PA

	Toddler PA	
	Low	High
No/low symptoms		
None/low PA		
Observed (expected)	1073 (1023.8)	**101** (**150.2**)
Standardized residual	1.5	**−4.0**
Moderate/intense PA		
Observed (expected)	593 (646.2)	**144** (**94.8**)
Standardized residual	−1.9	**5.1**
Moderate/high symptoms		
None/low PA		
Observed (expected)	354 (352.2)	49 (50.5)
Standardized residual	0.1	−0.2
Moderate/intense PA		
Observed (expected)	135 (136.5)	21 (19.5)
Standardized residual	−0.1	0.3
No/low symptoms		
None/low warmth		
Observed (expected)	159 (157.4)	19 (20.6)
Standardized residual	0.1	−0.4
Moderate/intense warmth		
Observed (expected)	1138 (1139.6)	151 (149.4)
Standardized residual	0.0	0.1
Moderate/high symptoms		
None/low warmth		
Observed (expected)	48 (52.4)	*12* (*7.6*)
Standardized residual	−0.6	*1.6*
Moderate/intense warmth		
Observed (expected)	325 (320.6)	42 (46.4)
Standardized residual	0.2	−0.6

PA: no symptom group Chi square = 47.76, $df = 1$, $p < .01$; symptom group Chi square = 0.17, $df = 1$, *ns*

Warmth: no symptom group Chi square = .17, $df = 1$, *ns;* symptom group Chi square = 3.42, $df = 1$, $p < .10$

Bold values indicate that the Chi square cell was significant ($p < .05$)

Italic values indicate that the cell was marginally significant ($p < .10$)

Table 2 Change in toddler PA in response to maternal behavior/PA

	Toddler PA		
	Decrease	No change	Increase
No/low symptoms			
None/low PA			
Observed (expected)	**200** (**231.8**)	585 (524)	226 (237.3)
Standardized residual	**−2.1**	1.8	−0.7
Moderate/intense PA			
Observed (expected)	**178** (**146.2**)	**299** (**342**)	161 (149.7)
Standardized residual	**2.6**	**−2.3**	0.9
Moderate/high symptoms			
None/low PA			
Observed (expected)	76 (81.6)	195 (190.4)	74 (73)
Standardized residual	−0.6	0.3	0.1
Moderate/intense PA			
Observed (expected)	38 (32.4)	71 (75.6)	28 (29)
Standardized residual	1.0	−0.5	−0.2
No/low symptoms			
None/low warmth			
Observed (expected)	37 (35.9)	89 (86.4)	35 (38.7)
Standardized residual	0.2	0.3	−0.6
Moderate/intense warmth			
Observed (expected)	247 (248.1)	595 (597.6)	271 (267.3)
Standardized residual	−0.1	−0.1	0.2
Moderate/high symptoms			
None/low warmth			
Observed (expected)	*17* (*11.9*)	23 (30.2)	14 (11.9)
Standardized residual	*1.5*	−1.3	0.6
Moderate/intense warmth			
Observed (expected)	65 (70.1)	185 (177.8)	68 (70.1)
Standardized residual	−0.6	0.5	−0.3

PA: no symptom group Chi square = 21.45, $df = 2$, $p < .01$; symptom group Chi square = 1.79, $df = 2$, *ns*

Warmth: no symptom group Chi square = 0.53, $df = 2$, *ns;* symptom group Chi square = 4.99, $df = 2$, $p = .08$

Bold values indicate that the Chi square cell was significant ($p < .05$)

Italic values indicate that the cell was marginally significant ($p < .10$)

random participants, suggesting that error terms would be related within a given participant. These ICCs indicated that 33.84, 40.94, and 24.96 % of variance in maternal PA, maternal warmth, and toddler PA, respectively, existed between toddlers, warranting a multilevel approach.

Next, we added linear and quadratic time variables to the models. The linear time variable began at 0 and increased by 1 for every interval. The quadratic time variable represented the squared value of the linear time variable. These variables have fixed slopes, which estimate the average slope across all participants, and it is also possible they may have random components, suggesting that the slope might vary from participant to participant. Deviance change tests were computed between two models (one without the random component and one including the random component) for the linear and quadratic terms separately to determine the appropriateness of including random components. These tests indicated that a random component should be included for the linear (χ^2s = 25.23–42.05, all ps $< .001$) and quadratic (χ^2s = 6.19–49.17, all ps $< .05$) terms for all three models.

Table 3 Change in maternal PA in response to toddler PA

	Toddler PA	
	Low	High
No/low symptoms		
Decrease PA		
Observed (expected)	265 (282.5)	**57** (**39.5**)
Standardized residual	−1.0	**2.8**
No change in PA		
Observed (expected)	971 (961.4)	125 (134.6)
Standardized residual	0.3	−0.8
Increase PA		
Observed (expected)	300 (292.1)	33 (40.9)
Standardized residual	0.5	−1.2
Moderate/high symptoms		
Decrease PA		
Observed (expected)	67 (70.7)	13 (9.3)
Standardized residual	−0.4	1.2
No change in PA		
Observed (expected)	317 (313.6)	38 (41.4)
Standardized residual	0.2	−0.5
Increase PA		
Observed (expected)	71 (70.7)	9 (9.3)
Standardized residual	0.0	−0.1

No symptom Chi square = 11.30, $df = 2$, $p < .01$

Symptom group Chi square = 1.97, $df = 2$, *ns*

Bold values indicate that the Chi square cell was significant ($p < .05$)

Next, we added the symptoms of depression score and its cross products with the linear and quadratic time variables. We examined models using both the continuous depression score and the categorical designation used in the contingency analyses. Across all models, no interactions existed, and neither variable for symptoms of depression exhibited a significant main effect (which would indicate that symptoms of depression influenced the intercept, or the expected value of the dependent variable at the first time point, when time = 0). Therefore, further results are reported only for the time variables.

In the maternal PA model, neither the linear nor quadratic terms reached significance ($\gamma = -0.02$, SE = 0.01, $t = -1.60$, $p = .114$). A similar result occurred with maternal warmth ($\gamma = -0.02$, SE = 0.02, $t = -1.42$, $p = .159$). The toddler PA model indicated a negative linear effect ($\gamma = -0.04$, SE = 0.01, $t = -3.32$, $p = .001$) and positive quadratic effect ($\gamma = 0.002$, SE = 0.001, $t = 2.73$, $p = .008$), suggesting a faster decrease at the beginning of the episode that leveled off later in time (i.e., a predominantly negative, concave upward slope). Given that each of these constructs are each declining across the episode, it makes more sense why, when contingency is observed, it is for declines in one construct following the other.

Discussion

The current study aimed to examine immediate, transactional effects of maternal warmth and PA and toddler affect in mothers with and without symptoms of depression. Although mothers in both groups displayed similar mean levels of PA, results indicated that mothers with no/low symptoms of depression exhibited mutually positive interactions with their toddlers, whereas mothers with moderate/high symptoms of depression did not. In line with previous research suggesting that mothers with elevated symptoms of depression exhibit less mutually positive interactions with their toddlers (e.g., Field 2008), this suggests that although mothers in both groups appeared to exhibit similar mean levels of PA, toddlers of those with higher symptoms were not as responsive to mother's positive displays. However, in response to maternal PA, toddlers of mothers with lower symptoms seemed to decrease in PA. This leaves ambiguity regarding the direction of effect for positive affect between mothers with no/low symptoms of depression and their toddlers. It is possible that these dyads are exhibiting more variation in their PA expressions, reflecting more dynamic interactions, and we are catching the decreases of these variations. The fact that the multilevel models suggested general decreases in PA across the observation supports this view. Possibly, the 10-s intervals used to code affect were not sensitive enough to capture effects for increases in positive affect. What can be concluded, however, is that dyads with mothers with no/low symptoms of depression displayed some type of covariation in positive affect, whereas dyads with mothers with moderate/high symptoms of depression did not. Further, these contingencies occurred despite similar mean levels of affective expression between the two groups, suggesting that there is something about the immediate interactions between mothers and their toddlers that differs between groups. Future work using more detailed coding of affect may contribute to a more fine-grained understanding of the ebb and flow of these interactions.

Results also indicated that mothers with moderate/high symptoms of depression did not exhibit the same covariation in PA with their toddlers as mothers with no/low symptoms. This finding is consistent with previous findings (e.g., Gelfand and Teti 1990) that depressed mothers respond less warmly and responsively to their children. However, the current study did not find significant bidirectional effects between toddlers and mothers with higher symptoms of depression, despite extant research finding that infants of mothers exhibiting depressed mood appear

distressed more often and respond less reciprocally to their mothers' attempts to elicit positive behavior (Zekoski et al. 1987), It is possible that this is due to low power, as only a small subset of the sample reported moderate/high symptoms of depression. Although the current study only examined immediate affective exchanges between mothers and toddlers and therefore cannot make conclusions about the long-term impact for toddlers, the results suggest that there are differences in the daily interactions between mother–child dyads with and without symptoms of depression, warranting further study.

Clinical Implications

Results of the current study have important implications for clinical interventions. For example, in Parent–Child Interaction Therapy (PCIT), parents are asked to engage in positive interactions with their child by emphasizing parental responsiveness and improving the quality of the parent–child relationship (Querido et al. 2002). However, findings from the current study suggest that mothers with elevated symptoms of depression may have more difficulty engaging in mutually positive interactions with their children. These findings are particularly important given that they were found in a sample of mothers with subclinical symptoms of depression, which are more prevalent in the population than clinical depression. Further, this occurred despite similar mean levels of affective expression between the two groups, suggesting that the more immediate interactions between mothers and toddlers may be important to consider. Results of the current study suggest that mothers with elevated symptoms of depression, even at subclinical levels, may be less able to engage in positive parent–child interactions, which may limit their ability to engage in treatments such as PCIT. Therefore, it may be important for clinicians to assess maternal symptoms of depression before beginning a parent training intervention or prevention program, and to understand specific challenges that mothers with elevated symptoms may have when asked to interact with their children.

Limitations and Future Directions

Results of the current study should be interpreted in the context of several limitations. First, it is possible that the 10-s intervals used in this study may not be sensitive to contingencies between mother and toddler behaviour and expressions. Using smaller intervals may better capture the intricacies and contingencies of mother and toddler affect and behavior, and may help clarify some of the unexpected or null findings of the current study.

The current study also utilized a relatively homogenous sample (European American, middle class). Maternal parenting goals and behavior have been shown to differ between eastern and western cultures and across socioeconomic status (e.g., Belsky and Jaffe 2006). Therefore, examining the current model in more diverse populations would elucidate how these associations are influenced by cultural and socioeconomic factors.

Relatedly, the current study utilized a community sample with limited representation of severe symptoms of depression. Indeed, only a small subset of mothers ($n = 20$) indicated the presence of symptoms of depression, and most that did endorse symptoms of depression tended to be in the mild to moderate rather than severe range. Thus, it is difficult to generalize the present effects to clinical depression during mother–child interactions. Examining this model in a clinical sample, or in a non-clinical sample that oversamples for more severe symptoms of depression, would provide additional and important insight into how clinical levels of depressive symptomatology influence mothers' abilities to adapt their behavior. Additionally, use of a clinical sample could potentially yield stronger effects, as oversampling extreme cases improves statistical power for moderation analyses (Cohen et al. 2003). However, subclinical symptoms of depression are more common among mothers than clinical levels of depression (e.g., McLennan et al. 2001), making it important to understand how processes operate in subclinical populations. Therefore, we believe that the use of a community sample could also be viewed as a possible strength of the current study, as employing a continuous measure of symptoms of depression in a non-clinical sample allows for investigation of these effects across the spectrum of symptoms of depression. Nevertheless, replicating these results in a more distressed sample would complement the current findings.

Future research should also aim to extend the scope of the current findings. For example, adding a measure of maternal anxiety would elucidate the effects of more global maternal internalizing symptoms, as previous research has illustrated that maternal anxiety is also related to impaired mother–child interactions, although perhaps not in the exact same way (e.g., Whaley et al. 1999). Additionally, the role of fathers is largely understudied in this area, and future research should be aimed toward clarifying how paternal psychopathology may influence immediate father-child interactions.

The results of the current study provide initial evidence that behavioral and affective manifestations of maternal symptoms of depression may have a negative immediate impact on toddlers' emotions, and that mothers with no/low symptoms of depression may have more reciprocal affective exchanges with their toddlers. These findings highlight the importance of considering transactional and immediate

effects when examining the impact of maternal depression on child outcomes.

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