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Externalizing Behavior Problems Among Polydrug Cocaine-exposed Children: Indirect Pathways via Maternal Harshness and Self-Regulation in Early Childhood

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Abstract

This study examined direct and indirect associations between prenatal cocaine exposure (CE) and children's externalizing problems in kindergarten via higher maternal harshness and lower self-regulation in early childhood. Other environmental risk variables such as child exposure to community violence and experience of hunger were used as additional predictors. The sample consisted of 216 mother-infant dyads recruited at delivery from local area hospitals (116 cocaine-exposed, 100 non-exposed). Maternal harshness was coded from observations of mother-toddler interactions at 2 years of age, and children's self-regulation was measured at 3 years of age using several laboratory paradigms. Maternal reports of externalizing behavior problems were obtained at both time points and at kindergarten. Teacher reports were obtained and classroom observations of externalizing behaviors were conducted in the kindergarten classroom. Results indicated significant indirect associations between CE and maternal reports of externalizing problems via higher maternal harshness at 2 years and higher externalizing problems at 3 years of child age. A second indirect path from CE to externalizing problems in the school setting via higher maternal harshness at 2 years and lower self-regulation at 3 years was also significant. There were significant associations between community violence exposure and maternal reports of externalizing problems, and between hunger and externalizing problems in the school setting. Results highlight the role of parenting and self-regulation in early childhood as critical process variables in the indirect association between CE and externalizing behavior problems in kindergarten.

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Keywords

Cocaine; Prenatal Exposure; Behavior Problems; Parenting; Self-Regulation

Introduction

The association between maternal cocaine use during pregnancy and externalizing behavior problems in children has been the focus of multiple studies due to impact of cocaine on brain regions involved in regulation of affect and behavior (Li et al., 2011; Liu & Lester, 2011). Results have been equivocal with some studies indicating no significant associations between CE and externalizing problems (Accornero, Morrow, Bandstra, Johnson, & Anthony, 2002; Bagner et al., 2009; Brown, Bakeman, Coles, Platzman, & Lynch, 2004; Warner et al., 2006), others indicating significant direct associations (Bada et al., 2011; Lester et al., 2009; Richardson, Goldschmidt, & Wilford, 2009), and yet others indicating associations mediated or moderated by other variables (Bailey et al., 2005; Delaney-Black et al., 2004; McLaughlin et al., 2011), or predicted by environmental factors (Bennett, Bendersky, & Lewis, 2002). There may be several reasons for these differences in findings such as timing and dose of exposure, measurement issues, and moderation by other variables. With regard to measurement of externalizing behavior problems, results have also varied by reporter or method of assessment, highlighting the need for multiple methods of assessment (Bendersky, Bennett, & Lewis, 2006; McLaughlin et al., 2011).

In addition to these factors, few studies have examined the potential for indirect associations between CE and externalizing behavior problems via potential intervening or mediating variables. The importance of intervening variables was recently highlighted in a dynamic cascade model of development of substance abuse problems (Dodge et al., 2009). This model emphasizes the role of cascading effects, where disruptions in salient issues at each stage of development prospectively predict salient outcomes at the next stage. In the case of the association between CE and externalizing behavior problems, two important stage salient issues are parenting and children's self-regulatory abilities (Bagner et al., 2009; Brown et al., 2004; R. D. Eiden, Edwards, & Leonard, 2007).

Parenting—Maternal cocaine use has the potential to alter parenting behavior. Both animal and human studies indicate that mothers with CE had lower plasma oxytocin (sometimes called the "bonding hormone") compared to non -substance using mothers (Johns, Lubin, Walker, Meter, & Mason, 1997; Light et al., 2004; McMurray et al., 2008). This has been demonstrated to be one mechanism for cocaine effects on maternal caregiving or parenting behavior (Light et al., 2004; McMurray et al., 2008). Animal studies examining the effects of cocaine administration on maternal caregiving behavior consistently report lower caregiving quality across multiple domains (Morrell, Basso, & Pereira, 2011). Similarly, a number of parenting dimensions have been examined in the human literature on CE. Results indicate that cocaine using mothers are at higher risk for being disengaged and passive during mother-infant interactions in the neonatal period (Gottwald & Thurman, 1994); are less flexible and engaged during feeding interactions (LaGasse et al., 2003); have lower responsiveness and enthusiasm in later infancy (Burns, Chethik, Burns, & Clark, 1997); are

less emotionally engaged in the toddler period (Molitor, Mayes, & Ward, 2003); use fewer positive reinforcements and more threats of physical discipline in the toddler/preschool period (Bauman & Dougherty, 1983); display more harshness during different laboratory based interactions at 2 years of age (R.D. Eiden, Schuetze, Colder, & Veira, 2011); and are more hostile and intrusive in a structured teaching situation at 3 years of age (Johnson et al., 2002). Among these different dimensions, the aspect of parenting that is most consistently associated with higher externalizing behavior is maternal hostility/harshness (Bradley & Corwyn, 2007; S.A. Erath, M. El-Sheikh, J. B. Hinnant, & E. M. Cummings, 2011; Olson et al., 2011). The association between maternal harshness and child behavior problems may reflect modeling of poor self-control, some aspect of temperamental risk transmission, or a combination of both. Indeed, harsh parenting has been associated with poor self-regulation which in turn is associated with externalizing behaviors providing a cascading chain of processes that predict externalizing behavior problems (Bradley & Corwyn, 2007).

Self-regulation—Children with higher levels of externalizing behavior problems by definition may have difficulty regulating their behavior in socially appropriate ways. Self-regulation is defined as the process of modulating behavior and affect given contextual demands (Posner & Rothbart, 2000). Although regulatory processes begin to develop in the prenatal period, regulation evolves into a complex and relatively stable self-initiated process by the preschool period (Calkins & Fox, 2002; Campbell, 2002). Thus, self-regulation may be the proximal, developmentally salient, mediator of the association between CE and externalizing behavior problems in a cascading link from CE to parenting to self -regulation. Indeed, several developmental theories provide persuasive explanations for the link between self -regulation in early childhood and disruptive behavior in later childhood, highlighting the importance of parenting behavior as a salient predictor of self-regulation (Bradley, 2000; Calkins & Fox, 2002; Schore, 1994, 1996). In addition, there is empirical evidence that the association between parenting and children's externalizing behavior problems is longitudinally mediated through the development of effective self-regulation (e.g., Eisenberg et al., 2005). Few previous studies have examined this issue among cocaine -exposed children, although previous studies have noted higher impulsivity and frustration reactivity among cocaine-exposed children (Dennis, Bendersky, Ramsay, & Lewis, 2006; Mayes, Grillon, Granger, & Schottenfeld, 1998).

Two related but distinct aspects of self-regulation in the preschool to early school age period have been delineated, effortful control and internalized conduct. Effortful control is the ability to suppress inappropriate behavior and perform required or appropriate behavior in response to environmental demands. Effortful control becomes increasingly important beyond the 2nd year of life, has considerable longitudinal stability, and predicts externalizing problems at later ages (Eisenberg, Zhou, et al., 2005; Kochanska & Knaack, 2003; Kochanska, Murray, & Coy, 1997; Rothbart, Derryberry, & Posner, 1994). Internalization of rules of conduct is regulated or appropriate behavior in response to contextual demands even in the absence of surveillance (Kochanska & Aksan, 1995; Kopp, 1982; Maccoby & Martin, 1983). The normative change from external monitoring of child behavior to more self-regulated behavior, even in the absence of close supervision, results from children internalizing rules of conduct. The attainment of these self-regulatory skills in the preschool

period sets the stage for successful adaptation during the transition to school and peer settings (Eisenberg, Zhou, et al., 2005). In spite of the importance of self-regulation as a key predictor of externalizing problems, few previous studies have examined this issue among cocaine-exposed children.

Child Gender—In addition to the role of maternal harshness and self-regulation as key mediators or intervening variables explaining the association between CE and child behavior problems, the literature has highlighted several moderators as well. Primary among them is child gender (Lewis & Kestler, 2012), although the direction of association has been mixed with some studies indicating higher risk for boys (Delaney-Black et al., 2012; Delaney-Black et al., 2004) and others indicating higher risk for girls (McLaughlin et al., 2011). Given these mixed findings, we examined gender as a moderator of the association between CE and externalizing problems but did not have a specific hypothesis regarding direction of association.

Role of Environmental Risk Factors—In addition to these mediators and moderator, several current environmental risk factors have been implicated as significant predictors of child behavior problems. One key aspect of the postnatal environment that may be especially critical among low-income substance using families is exposure to community violence. Substance-abusing women are particularly likely to experience violent encounters due to vulnerability to victimization (R. D. Eiden, Peterson, & Coleman, 1999), unstable relationships (Lynch & Cicchetti, 1998), and residence in high-risk neighborhoods (Osofsky, Wewers, Hann, & Fick, 1993). Several studies report that preschoolers who witnessed violent acts were at risk for increased behavior problems (Farver, Xu, Eppe, Fernandez, & Schwartz, 2005; Shahinfar, Fox, & Leavitt, 2000; Taylor, Zuckerman, Harik, & Groves, 1994). Thus, maternal substance use during pregnancy may be a marker for greater environmental risk including the risk for exposure to community violence. Given the salience of violence exposure to development of children's behavior problems, exposure to violence may be an additional postnatal risk factor for children of substance using mothers.

Low-income children living in high risk situations are also more likely to experience food insecurity defined as limited access or ability to acquire sufficient, safe, and nutritious food (Melchior et al., 2009). Several studies have reported significant associations between food insecurity and children's externalizing behavior problems (Ashiabi & O'Neal, 2008; Huang, Oshima, & Kim, 2010; Slopen, Fitzmaurice, Williams, & Gilman, 2010), even after controlling for variables such as parental stress, depression, and warmth (Slack & Yoo, 2005). Hunger represents more extreme or severe form of food insecurity. The large majority of cocaine-exposed and control cohorts that have been studied to date are from low -income samples. However, few have examined the role of hunger as a predictor of child behavior problems in these samples. Child exposure to violence and hunger were not hypothesized as mediators given the high risk for these variables for the sample as a whole. Both the cocaine-exposed and control group families included in this study were at high demographic risk and many women in the control group were substance users, although they did not use cocaine during pregnancy.

Thus, we examined a conceptual model for development of externalizing behavior problems among cocaine-exposed and demographically similar non -exposed children that included the role of additional environmental risk factors such as exposure to community violence and child experience of hunger. Moreover, in addition to potential direct effects of CE on externalizing behavior problems in kindergarten, two indirect pathways linking maternal cocaine use to children's externalizing problems were also examined in this study: the path from maternal cocaine use → higher maternal harshness at 2 years → lower self-regulation at 3 years → higher externalizing problems in kindergarten. Second, the path from maternal cocaine use → higher maternal harshness at 2 years → higher externalizing problems at 3 years → higher externalizing problems in kindergarten. We examined the role of child gender as a potential moderator of the direct association between CE and externalizing behavior problems. We used multiple methods including caregiver reports on multiple measures of externalizing problems, teacher reports on multiple measures of externalizing problems, and classroom observations of externalizing problems. Given the normative trajectory of externalizing problems of gradual increases into the early preschool years followed by a sharp decline between 3 and 4 years (Campbell, 1995; Edwards, Eiden, Colder, & Leonard, 2006; Nagin & Tremblay, 1999), children who continue to display externalizing problems at kindergarten may be at particularly high risk for developing later psychopathology (Campbell, 1995; Nagin & Tremblay, 1999).

Method

Participants

The sample consisted of 216 mother-infant dyads participating in an ongoing longitudinal study of CE(116 cocaine-exposed or CE, 100 not cocaine-exposed or NCE). An outreach worker on the project staff recruited all participants after delivery from two local area hospitals. Mothers ranged in age from 18 to 42 years (*M*=29.53; *SD*=6.06). The majority of mothers were African American (72%), were receiving Temporary Assistance for Needy Families (76%) at the time of their first laboratory visit (Years 2001–2004), and were single (66%). Of the 216 children, 106 (49%) were male. All families were recruited from two hospitals serving a predominantly low-income population and the two groups were matched on maternal education, maternal race/ethnicity, and infant gender. The study received approval from the children and youth institutional review board of the University at Buffalo. Informed written consent was obtained from all recruited participants. Participants were compensated for their time in the form of gift certificates, checks, and infant toys at each assessment, with the amount increasing over time.

Maternal and child assessments were conducted at 4–8 weeks, 7, 13, 24, 36, and 48 months of child ages, and at kindergarten age. Children born at or before 37 weeks gestation were scheduled for their appointments at chronological age corrected for prematurity until the 24 month assessment. Measures obtained at the 4–8 week, 24 and 36 months, and at kindergarten were included in the current analyses. By kindergarten, 55 children in the CE group and 9 children in the NCE group had been removed from parental care and placed in non-parental care. All assessments were conducted with the primary caregiver of the child at that time, although for ease of presentation the terms mother and maternal are used

throughout the manuscript when referring to the primary caregiver. The primary caregiver was identified as the adult who had legal guardianship of the child and accompanied the child at all appointments. The average child age at kindergarten was 5.52 years (*SD*= .36, range = 4.8–7.0 years).

Procedure

All mothers were screened after delivery for initial eligibility and matching criteria. Interested and eligible mothers were given detailed information about the study and asked to sign consent forms. About 2 weeks after delivery, mothers were contacted and scheduled for their first laboratory visit, which took place at the time that their infant was approximately 4–8 weeks old. All visits consisted of a combination of maternal interviews, observations of mother-infant interactions, and infant assessments. In the circumstance of a change in custody arrangements, the person who had legal guardianship of the child was contacted and asked to participate. Biological mothers were interviewed at the 4–8 week assessment in addition to the foster mother in order to obtain accurate information about prenatal substance use.

Once a family was recruited into the cocaine group, the closest matching NCE group family (based on maternal education, race/ethnicity, infant gender) was recruited. However, a significantly higher proportion of mothers in the NCE group declined participation or withdrew before formal enrollment, resulting in a smaller number of families in the control group. Mothers in the comparison group reported not having used any illicit substances other than marijuana. They also tested negative for cocaine or illicit substances other than marijuana based on urine and hair analysis results. Additional exclusionary criteria for all mothers were (a) maternal age younger than 18 years, (b) use of illicit substances other than cocaine or marijuana, and (c) significant medical problems for the infant (e.g., genetic disorders, major perinatal complications, baby in critical care for over 48 hours). Of the women screened at delivery, 126 acknowledged using illicit substances other than cocaine or marijuana at the screening interview and 149 infants had major medical problems. Thus, a total of 275 women were excluded based on these two criteria.

Of the 4,800 women screened at delivery, 340 were eligible for participation in either group. Of these 340 women, 35% either declined participation or were not enrolled in the study because they expressed initial interest but later withdrew, resulting in a sample of 220 mother-infant dyads. Of these 220 mother-infant dyads, 4 were excluded from analyses (two infants were later diagnosed with fetal alcohol syndrome, one was later diagnosed with shaken baby syndrome, and one infant was severely delayed), resulting in a final sample of 216 dyads. Mothers who participated were more likely to be between 18 and 25 years of age, ($p < .001$), and were more likely to have a high school or below high school education ($p < .001$), compared to those who were eligible but not enrolled. Mothers who participated were also more likely to be in the CE group (with a participation rate of 91% among CE group eligible families) compared to those who were eligible but not enrolled. The majority of mothers in the CE group who were eligible but not enrolled in the study had children who were placed in non-maternal care. There were no other differences on any demographic variables between those who participated and those who were eligible but not enrolled or

between mothers in the CE group who participated compared to those who did not. Of the potentially eligible NCE mothers based on screening information, 216 were approached for participation because they were the closest match to a cocaine group participant. Of these, 22 refused participation, 56 did not keep their first appointment within the narrow window (4–8 weeks of infant age), we were unable to locate 21 participants, and 17 were recruited into the cocaine group because their hair analysis was positive for cocaine. The remaining 100 were recruited into the control group.

Assessment of growth and risk status

Three measures of growth were used in this study: birth weight (gm), birth length (cm), and head circumference (cm). All measurements were taken by obstetrical nurses in the delivery room and recorded in the infant's medical chart. Research staff recorded this information from the charts after recruiting the mother-infant dyad. Medical chart review at the time of recruitment also was used to complete the Obstetrical Complications Scale (OCS; Littman & Parmelee, 1978), a scale designed to assess the number of perinatal risk factors experienced by the infant. Higher numbers on this scale indicate lower obstetrical risk. Gestational age was calculated by dates and extracted from medical records.

Identification of Substance Use

Cocaine status was determined by a combination of maternal report, chart review, and maternal hair analysis. Urine toxicologies were routinely conducted at the first prenatal visit on maternal urine and/or at delivery (for those mothers who tested positive prenatally, obtained prenatal care elsewhere, or did not receive any prenatal care) on infant and maternal urine by participating hospitals. Mothers were included in the CE group if self-reports were positive, regardless of urine toxicology or hair-sample results. Similarly, mothers who reported that they did not use cocaine but had positive urine toxicology or hair samples were included in the CE group. Approximately 90% (n = 195) of infants and mothers in the study had urine samples available for assay and hair samples were collected for all participants.

Urine toxicologies consisted of standard urine screening for drug level or metabolites of cocaine, opiates, benzodiazepines, and tetrahydrocannabinol. Urine was rated positive if the quantity of drug or metabolite was >300 g/ml. Hair samples were collected from the mothers at the first laboratory visit and sent to the Psychemedics Corporation for Radioimmunoanalyses (RIAH). Hair samples were screened for cocaine followed by a gas chromatography/mass spectrometry (GC/MS) confirmation for positive cocaine screens. Drugs and their metabolites are absorbed into the hair and can be extracted and measured. As hair grows at an average rate of 1/2 inch per month, it can record a pattern of drug consumption related to the amount and frequency of use (see Baumgartner et al., 1989). Thus, a 2-inch length of hair could contain a record of approximately 4 months of use, and given adequate hair length (i.e., about 4–5 inches), use per trimester may be recorded. Drugs become detectable in hair about 3 to 4 days after use, a time when cocaine is rendered undetectable by urinalysis. RIAH is the most well-established hair-analysis technique and has been replicated by independent laboratories across the world (see Magura et al., 1992). GC/MS confirmations of RIAH have not revealed any false positives because of testing

errors (Magura et al., 1992). Special washing techniques and data pertaining to kinetics of washing were used to distinguish external contamination from intentional use. These methods have been verified by independent investigators to distinguish between passive and active exposure (see Mieczkowski & Newel, 1997).

Approximately 55% of the mothers in the CE group had positive urine toxicologies at delivery, and 79% of the mothers in the CE group had hair samples that tested positive for cocaine during pregnancy. There were 23 mothers in the CE group who did not have a positive toxicology result on any biomarker of cocaine, but all of these mothers admitted to having used cocaine in the brief self-report screening instrument administered after delivery.

The Timeline Follow-Back Interview (TLFB; Sobell et al., 1986) was used to assess maternal substance use during pregnancy and postnatally. The postnatal interview at 24 and 36 months asked about substance use over the past year. Participants were provided a calendar and asked to identify events of personal interest (i.e., holidays, birthdays, vacations, etc.) as anchor points to aid recall. This method has been established as a reliable and valid method of obtaining longitudinal data on substance-use patterns, has good test-retest reliability, and is highly correlated with other intensive self-report measures (Brown et al., 1998). The TLFB yielded data about the average number of days of cocaine use per week, average number of joints smoked per week, average number of cigarettes smoked per week, and average number of standard drinks per week during pregnancy. Average number of days per week of cocaine use during pregnancy based on the TLFB ranged from 0 to 6.63 days. Postnatal substance use was computed by taking the average of number of days used cocaine, number of cigarettes per week, number of standard drinks per week, and number of joints per week from the 4–8 week, 24 and 36 months, and kindergarten assessments.

Maternal Harshness—Intensity of maternal harshness was coded during specific segments of the 24 month observational assessments. These included a 10-minute mother-child free play paradigm, a 10 minute clean-up, 8-minute structured play, 10-minute eating a snack, and 5-minute emotion regulation paradigm. Following previous studies (Keenan and Shaw, 1994), this allowed for coding of maternal harshness across varying levels of stress, from none (e.g., during free play), to moderate (clean up), to higher levels of stress (emotion regulation paradigm). For free play, mothers were asked to spend some time with their children as they normally would at home in a room with age appropriate toys. This was followed by the clean-up paradigm. Mothers were asked to have their children clean up the toys, with the primary responsibility for toy clean up being the child's. During snack, mother-child dyads were presented with a choice of snacks and drinks and spent time eating, and looking at books if they finished eating before 10 minutes. The structured play situation consisted of a series of goal oriented tasks (e.g., puzzles, sorting, etc.). Mothers were asked to have the child complete each task. During the 5-minute emotion regulation paradigm, mother-child dyads were left in the room with no toys or activities to interest the child. Mothers were asked to sit at a table and complete questionnaires. This situation is generally stressful for mothers and children, and reflective of naturalistic situations where mothers may have competing demands on their attention (Newby & Campbell, 1999).

Maternal harshness was coded on the basis of codes developed for children in previous studies (Cummings et al., 1989; Keenan & Shaw, 1994). This included physical harshness (hitting, kicking, pushing) directed toward a person; physical harshness directed toward an object (e.g., banging, throwing); verbal harshness that consists of cursing (use of obscene language or gestures); and verbal harshness that consists of threats (words used to attack a person or threats of harm). Event coding of each aggressive episode was triggered by the mother displaying any of these behaviors. An overall rating of intensity of maternal harshness (based on all events) was coded along a 5-point scale ranging from 0 = no harshness to 4 = severe harshness. Two coders blind to group status rated maternal harshness. They were trained by the first author until inter-rater reliability criterion was reached (agreement of 90% or above). Subsequently inter-rater reliability was established on 20% of the tapes. Inter-rater reliability on intensity of maternal harshness was high (intra-class correlation of .87). This measure of maternal harshness was associated with theoretically relevant variables in predictable ways. For instance, observations of harsh maternal behavior was significantly and positively associated with maternal reports of punitive parenting ($r = .16$, $p < .05$) based on the Coping with Children's Negative Emotions Scale (Fabes, Poulin, Eisenberg, & Madden -Derdich, 2002); with maternal physical ($r = .20$, $p < .05$) and verbal aggression ($r = .18$, $p < .05$) subscales of the Buss-Perry Aggression Questionnaire (Buss & Perry, 1992); and with maternal experience of intimate partner physical and sexual violence ($r = .24$, $p < .01$) based on the Conflict Tactics Scale-2 (Straus, Hamby, Boney-McCoy, & Sugarman, 1996).

Child Self-Regulation at 36 Months—The construct of self-regulation used in data analyses consisted of three measures, two effortful control measures (snack delay and prize delay) and an observational measure of internalization of rules of conduct. The effortful control tasks were taken from a battery of tasks developed by Kochanska, Padavich, & Koenig (1996) and Kochanska and Knaack (2003). These measures have been used extensively in developmental studies, have high internal consistency, and high construct and predictive validity (see Kochanska et al., 1996; 2003). In the first task, snack delay, the child has to wait for the experimenter to ring a bell before retrieving an M&M from under a glass cup (four trials: delays of 10, 20, 30, and 45 seconds). Halfway through the delay, the experimenter lifts the bell but does not ring it. Codes were assigned as follows: 0 (eats the snack before the bell is lifted), 1 (eats the snack after the bell is lifted), 2 (touches glass or bell before bell is lifted), 3 (touches glass or bell after the bell is lifted) and 4 (waits for the bell to ring before touching cup or snack). The mean score on all four trials was used as the effortful control score on this task. In the second task, prize delay, the child is asked to sit on a chair facing away from the table where the experimenter is noisily wrapping the gift. The child is asked not to peek. The experimenter leaves the room for 2 minutes, asking the child not to touch the gift until she returns. Coding involves a peeking score (on a 5-point scale ranging from 0 = out of seat to 5 = never turned to peak), a latency to peek score, and latency to touch score. The scores were standardized and the average of these three standard scores was used as the composite measure for prize delay. Higher scores on both composite measures indicated higher effortful control.

Observations of child internalization were conducted according to the paradigm developed by Kochanska and her colleagues (Kochanska & Aksan, 1995; Kochanska et al., 1996). Mothers were instructed to show the child a shelf with attractive objects when they entered the observation room and to instruct the child to not touch those objects. Mothers were told that they could repeat this prohibition and/or take whatever actions they would normally take to keep their child from touching these prohibited objects during the hour-long session that followed (consisting of free play, structured play, clean-up, reading, etc.). About an hour into the observation session in the room with the prohibited objects, the experimenter asked the mother to move to the front of the room. A screen dividing the room in half was partially closed so that the parent and the child were unable to see each other. The child was asked to stay on the side of the divider containing the prohibited objects and sort plastic cutlery while the experimenter interviewed the mother on the other side of the room.

Children's internalization of the maternal directive to not touch the objects on the prohibited shelf was assessed during the 12-minute observational paradigm (Kochanska & Aksan, 1995). During the first 3 minutes of the internalization paradigm, the child was left alone with the cutlery task. At the end of this time, a female research assistant unfamiliar to the child came in and played with the prohibited objects with obvious enjoyment for 1 minute and then left the room. Prior to leaving, she wound up the music box, started the music, and replaced it on the shelf. The child was left with the cutlery sorting for the next 8 minutes. The child's behavior was coded for every 15 second interval according to the coding criteria developed by Kochanska and Aksan (1995), consisting of 6-point rating scales with 0 = playing with prohibited objects in a "wholehearted", unrestrained manner to 6 = sorting cutlery. The final composite score for internalization was computed by taking the average rating across the intervals and was then standardized. Internalization was coded by two independent coders blind to group status and inter-rater reliability was computed for 15% of the sample. Inter-rater reliability for internalization was high (Intra-class correlation coefficient of .99). The scores for snack delay, prize delay, and internalization were averaged into one composite score reflecting high self-regulation, and had an internal consistency of $\alpha = .72$.

Child Behavior Problem—Maternal reports of externalizing behavior problems were obtained at 24 and 36 months and at kindergarten using the externalizing behavior subscales of the 1 ½ to 5 year version of the Child Behavior Checklist (CBCL; Achenbach, 1992). The CBCL is a widely used measure of children's behavioral/emotional problems. It consists of 100-items on a three-point response scale ranging from "not true" to "very true," with some open-ended items designed to elicit information about a particular problem behavior. Higher scores indicate more externalizing behavior problems. Raw scores were used in all analyses and T scores were used for descriptive purposes. About 10%of children in this sample had T scores in the borderline/clinical range (*T* score of ≥60) by kindergarten according to maternal reports on the CBCL.

In addition to the CBCL, maternal and teacher reports of externalizing behavior problems were obtained using the Behavior Assessment System for Children-II (BASC-II), parent (PRS) and teacher report scales (TRS) (Reynolds & Kamphaus, 2002) and the Swanson, Nelson, and Pelham-IV questionnaire (SNAP-IV) (Swanson, Nolan, & Pelham, 1982). The

BASC-II PRS consists of 160 items and the TRS consists of 139 items that measure social, adaptive, externalizing, and internalizing behaviors. The externalizing behavior scales consisting of items measuring aggression, conduct problems, hyperactivity, and attention problems were used in the current analyses. The scale has been widely used for clinical and research purposes, has good convergent and discriminant validity, high temporal stability, and high internal consistency (Baxter & Rattan, 2004; Gladman & Lancaster, 2003; Jarratt, Riccio, & Siekierski, 2005). Approximately 29% of children in this sample (24% NCE, 33% CE) were at or above the clinical cut-off on the TRS. The SNAP-IV is a 90-item measure with each item rated on a 4 -point scale ranging from “Not at all” to “Very Much”. The SNAP-IV has been used extensively in ADHD and general school samples and has acceptable psychometric properties (Bussing et al., 2008). Maternal and teacher reports on the continuous measures of aggression-defiance (AD) and oppositional defiant disorder (ODD) symptoms were used in the current analyses.

The Student Observation System (SOS) of the BASC-II was used for observational assessment of classroom behavior. The SOS uses momentary time sampling to record a wide range of child behavior, including both adaptive social behaviors and negative or problem behaviors (e.g., inattention, disruptive behaviors). The count of problem behaviors across six 15-minute episodes was averaged to derive a composite score for average problem behaviors across 90 minutes of classroom observations for the current analysis. Coders blind to all information about the child’s family conducted the observations at the child’s school. Coders were trained to a minimum inter-rater reliability criterion of r = .80 on the problem behavior scale. Initial training was followed by inter-rater reliability checks at 4 week intervals on 4–5 school observations. Inter-rater reliability was Kappa = .87 for the problem behavior composite. Observers coded time of day (morning vs. after lunch), classroom organization/structure during the observation/activity (1 = no apparent structure during the observational period/chaotic to 5 = well structured, organized classroom with clear rules), number of students in the classroom, and if the child was in a special education classroom (yes/no). About 93% of the observations were conducted in the morning (9 am). The remaining 7% were conducted in the afternoon. There was no association between time of day and observations of problem behavior. Similarly, being in a special education classroom, classroom organization/structure during observation, or number of students in the class was not associated with problem behavior.

Child Exposure to Community Violence—Mothers completed the Survey of Exposure to Community Violence (Richters & Saltzman, 1990) for their children during the kindergarten assessment. The measure evaluated child exposure to severe violence (e.g. stabbing, shooting, and rapes), moderately severe violence (e.g. threats, accidents, and drug deals), and less severe violence (e.g., beating and chasing). For each violent event, mothers reported “true” or “false” if their child had witnessed (19 items; e.g., “seen someone getting beaten up”) or been the victim (7 items; e.g., “child has been threatened with serious physical harm by someone”) of a violent act. The sum of all items was computed. Approximately 33% of the children in this sample experienced some level of violence exposure. However, this continuous measure was extremely skewed and kurtotic with a

large number (67%) of mothers reporting no community violence exposure for their children. Thus, this measure was dichotomized (no vs. some violence exposure).

Child Hunger—Child hunger was measured using the Community Childhood Hunger Identification Project (CCHIP) scale (Wehler, Scott, & Anderson, 1991). The CCHIP scale consists of 8 items with a dichotomous (yes, no) response choice and asks whether they or their children had experienced different aspects of hunger over the past 12 months. The individual item scores were summed to create an overall hunger score with total scores ranging from 0–8. The scale has excellent reliability and validity and has been used in several studies of childhood hunger (Murphy et al., 1998; Wehler et al., 2004).

Data Analytic Strategy—Group differences in demographics, perinatal risk characteristics, maternal substance use variables, and the exogenous variables included in the model were examined first using ANOVAs or MANOVAs in order to provide descriptive data and guide selection of potential covariates. MANOVAs were used when multiple theoretically associated constructs were the dependent measures in order to control for high Type I error rate. MANOVAs were used to examine gender differences in externalizing behaviors. Demographic or perinatal risk variables that were associated with both the exogenous variables and indices of externalizing behavior problems at $p < .10$ were used as covariates in subsequent analyses. Structural equations modeling (SEM) was used to test the hypothesized model with maternal harshness and child self -regulation as intervening variables between maternal substance use and externalizing problems. Maternal reports of externalizing problems at 24 and 36 months were included in the model to account for within time associations with the intervening variables. Multiple group analyses were used to examine moderation by gender. These models examined if the potential direct associations between maternal substance use and externalizing behaviors in kindergarten differed for boys and girls. None of the intervening variables were included in these models. These models were tested by comparing fully constrained with fully unconstrained models. The $\Delta\chi^2$ was used as an omnibus test of differences across child gender. SEM analyses were conducted using Mplus, Version 5.2 software (Muthen, 1998–2004) using full-information maximum likelihood estimation procedures (Arbuckle, 1996). Indirect effects were tested using the bias-corrected bootstrap method. This method has been found to provide a more accurate balance between Type 1 and Type 2 errors compared with other methods used to test indirect effects (MacKinnon, Lockwood, & Williams, 2004). Five thousand bootstrap samples and the 95% bias-corrected confidence intervals (CIs) were used to test significance of indirect effects.

Missing Data—As expected in any longitudinal study, there were some incomplete data for some of the participants at one or more of the four assessment points included in this study. Of the 216 mother-infant dyads who completed the 4-to 8 -week laboratory visit, 177 completed the 24 month assessment, 165 completed the 36 month assessment, and 164 completed the kindergarten assessment.

There were no significant differences between families with complete vs. missing on any of the variables included in this study and demographics at any age until the kindergarten assessment. Families with missing data at kindergarten had lower maternal education, $F(1,$

213) = 4.82, p < .05 (*M* = 11.89 and 11.26 for those with complete vs. missing data respectively, *SD*= 1.73 and 2.06). Mothers with missing data at the kindergarten assessment also were more likely to smoke in pregnancy compared to those with complete data, *F*(1, 213) = 5.24, p < .05 (*M*= .87 and 3.01 for those with complete and missing data respectively, *SD* = 4.50 and 8.82). Finally, 36.5% of children with missing data at kindergarten were in foster care compared to 22% of those with complete data, Pearson χ^2= 4.02, p < .05. Data were thus determined to fit criteria for missing at random (MAR), but not missing completely at random (MCAR). As noted earlier, full-information maximum likelihood was used to estimate model parameters for SEM. Variables that were significantly different for families with missing vs. complete data (maternal education, number of cigarettes per day used during pregnancy, and foster care status) were included in model testing as exogenous variables.

Results

Consideration of Covariates and Descriptive Data—Group differences in demographic and perinatal risk variables are presented in Table 1. Group differences in other variables included in the model are presented in Table 2. As noted in Table 2, CE was significantly associated with higher teacher rated aggression/defiance. There were no other direct associations between CE and externalizing problems. Results from correlational analyses for all variables included in the model are presented in Table 3. Among demographic variables, maternal education was associated with maternal substance use (cigarettes and alcohol), with maternal harshness, and with children's self-regulation variables, but not with externalizing behaviors. Accordingly, maternal education was included as an exogenous variable in the model. There were no significant associations between any of the perinatal risk variables and the other variables in the model. MANOVA with child sex as the independent variable and the four maternal report variables as the dependent measures indicated no significant gender differences in externalizing behaviors according to maternal or teacher reports. Thus, child gender was not included in as a covariate in the testing of the overall model. There was a significant multivariate effect of foster care status, *F*(3, 161) = 2.78, *p* < .05 on the three self-regulation variables, but not on externalizing behavior problems. Univariate analyses indicated that children in foster care had higher scores on prize delay indicating higher effortful control on this measure (*M*= −. 10 and .48, *SD*= .91 and 1.26). In addition, foster care mothers of cocaine-exposed children displayed lower intensity of harshness (*M*= 1.45 vs. 2.28, *SD*= 1.37 and 1.26). Thus, foster care status was used as a covariate in model testing.

Model Testing—Average number of joints per week during pregnancy was not associated with CE group status, or with the mediators or outcomes examined in this study. Thus, this variable was dropped from model testing. Similarly, initial analyses with per trimester substance use data yielded no significant associations between cocaine, cigarettes, marijuana, or alcohol use per trimester based on maternal self-reports and any of the measures of externalizing behavior problems. Thus, model testing was conducted with composite measures of substance use across pregnancy.

Examination of bivariate correlations indicated low correlations between maternal report and the classroom based measures (teacher reports and observations, see Table 2). Thus separate confirmatory factor analyses were conducted on maternal reports scales and the measures based on classroom behaviors (teacher reports and observations). Confirmatory factor analysis conducted on the four maternal report scales of externalizing behaviors (CBCL, BASC-II PRS, SNAP-IV AD, and ODD scales) indicated that they loaded on one factor reflecting maternal reports of high externalizing behavior problems, ($\chi^2(1) = 4.18$, $p < .05$, CFI =.99, RMSEA = .02), with standardized factor loadings of .97, .77, .81, and .83 for the four measures respectively. Confirmatory factor analysis conducted on the four teacher report and observation measures (BASC-II TRS, SNAP-IV AD, and ODD scales, and BASC-II SOS) indicated that they loaded on one factor reflecting teacher reports and observations of externalizing behaviors ($\chi^2(2) = 4.91$, $p = .09$, CFI = .99, RMSEA = .08) with standardized factor loadings of .85, .96, .99, and .50 respectively.

The hypothesized model tested included maternal harshness and child self-regulation as potential mediators or intervening variables between maternal substance use during pregnancy and externalizing behaviors in kindergarten. Child exposure to violence and hunger were included as additional predictors reflecting higher environmental risk. The model also included the within time covariance between maternal harshness at 24 months and externalizing behavior problems at 24 months as well as the covariance between self-regulation at 36 months and externalizing behavior problems at 36 months. Foster care status and maternal education were included as covariates in the model (see Figure 1). Goodness of fit indices indicated that this hypothesized model fit the data well, ($\chi^2(116) = 140.65$, $p = .06$, CFI = .98, RMSEA = .03, 95% CI [.00, .05]. The structural paths indicated that mothers in the CE group displayed higher harshness during interactions with their 24 month olds, and higher maternal harshness toward the child at 24 months was associated with lower child self-regulation and higher externalizing behavior problems at 36 months. Lower child self-regulation at 36 months was a prospective predictor of higher externalizing behavior problems at kindergarten according to teacher reports and observations. However, it was not associated with maternal reports of externalizing problems. Child exposure to violence was associated with higher externalizing behaviors at kindergarten age according to maternal reports. Higher family hunger was associated with higher externalizing behaviors in the school setting (teacher reports and observations). Addition of postnatal substance use variables to the model did not yield any significant associations between postnatal substance use variables and externalizing behavior problems. Thus, postnatal substance use was not included in the final model. Addition of direct paths from PCE to self-regulation or PCE to externalizing behavior latent variables did not improve the fit of the model.

Our model included hypotheses about several indirect effects, and the pattern of path coefficients provided evidence for two potential intervening variables. The association between maternal cocaine use and externalizing behavior problems according to maternal reports via higher maternal harshness 2 years and externalizing problems at 3 years was statistically significant, B= .36, 95% CI[.13, .78]. The indirect association between maternal cocaine use and externalizing problems in the classroom setting via higher maternal

harshness at 2 years and self-regulation at 3 years was also statistically significant, B = .23, 95% CI[.01, .77].

Moderation by Child Gender

We examined moderation by child gender using multiple group analyses in SEM. This model only included the exogenous variables and the two latent variables for child behavior problems, but not the mediators. We first examined fit indices for a fully unconstrained model for boys and girls and compared this unconstrained model with a fully constrained model. The chi-square change between these two models was not significantly different ($\Delta\chi^2(24) = 34.97$, $p > .05$), suggesting that the model was equivalent for boys and girls.

Discussion

Few studies of CE have examined indirect pathways to externalizing behavior problems. Indirect pathways that are prospective may be especially important as they suggest a cascade of events that may predict risk for a particular child outcome, with implications for timing and content of preventive interventions. The results from this study indicated two indirect pathways by which maternal cocaine use during pregnancy may be associated with externalizing behavior problems upon entry into kindergarten. The first was a pathway from maternal cocaine use to higher maternal harshness at 2 years, predicting lower self - regulation at 3 years, which in turn would predict higher externalizing behaviors at kindergarten age. The second was a pathway from maternal cocaine use to higher maternal harshness at 2 years, to higher externalizing behaviors at 3 years, to higher externalizing behaviors in kindergarten.

Contrary to hypotheses, there were no direct associations between maternal cocaine use and externalizing behaviors in kindergarten with the exception of teacher reports of higher aggression/defiance among CE children compared to NCE children. A number of animal and human studies report higher levels of child aggression among prenatally cocaine-exposed compared to non-exposed children. For instance, Bendersky et al. (2006) reported high levels of child aggression as measured by caregiver, teacher, and child reports among cocaine-exposed children at age 5. The association between CE and high levels of child aggression remained for cocaine-exposed boys in the same sample at 10.5 years of age (Bennett, Bendersky, & Lewis, 2007). Others have reported high levels of aggression among cocaine-exposed girls without prenatal alcohol exposure at 6–7 years of age (Sood et al., 2005), and for cocaine-exposed children in foster care at age 6 (Linares, 2006). Animal studies are supportive of these results indicating higher aggression in cocaine-exposed compared to non -exposed rats (Johns, Zimmerman, Noonan, Li, & Pedersen, 1994; Wood & Spear, 1998), and higher frequency and duration of aggression among cocaine-exposed male rats (Johns & Noonan, 1995). Current results with regard to teacher reports of aggression/defiance are supportive of these findings.

However, current results indicated no direct associations with maternal reports and with other indices of school based externalizing behaviors. There are a number of possible explanations for lack of direct associations with these measures of externalizing behaviors. One explanation may be differences across studies in number of children in foster care. A

large number of cocaine-exposed children in the current study were in foster care (including kin care) by kindergarten age and foster care mothers exhibited lower levels of harshness during interactions with the child. It is possible that this had a cascading protective effect on lower externalizing behavior problems among cocaine-exposed children, although we did not have sufficient sample size to examine moderation by foster care status. The rates of foster care were never reported in the studies by Bendersky and colleagues (Bendersky et al., 2006; Bennett et al., 2007). The other two previous studies reported significant direct associations for only a subset of cocaine-exposed children, those not exposed to alcohol (Sood et al., 2005), or those in foster care only (Linares, 2006). A second possible explanation between differences in results may also be due to differences in amount, duration, and timing of exposure that are more difficult to determine. The current results regarding lack of direct associations between CE and child externalizing problems are similar to at least three previous studies of CE (Accornero et al., 2002; Bagner et al., 2009; Brown et al., 2004).

Results from model testing indicated that there was a significant indirect association between CE to externalizing problems by maternal report via higher maternal harshness at 2 years and higher externalizing problems at 3 years of child age. There was also a significant indirect association between CE to externalizing problems in the school setting via higher maternal harshness at 2 years and lower self-regulation at 3 years. These results highlight the important role of maternal harshness as the common distal mediator of the association between maternal cocaine use and externalizing problems in kindergarten. Results are supportive of previous studies indicating that harsh parental discipline is a significant predictor of child behavior problems among CE children (Bennett et al., 2002). The results are also similar to previous studies (Yumoto, Jacobson, & Jacobson, 2008) reporting that emotional responsiveness of the primary caregiver and the emotional climate of the home are among the most important predictors of behavioral outcomes such as aggression and delinquency. Finally, results are supportive of the larger literature on the association between harsh parenting and poor child outcomes such as behavior problems, aggression, and emotion regulation (Callahan et al., 2011; Chang, Schwartz, Dodge, & McBride-Chang, 2003; S. A. Erath, M. El-Sheikh, J. B. Hinnant, & E. M. Cummings, 2011).

There has been strong empirical support in the general developmental literature that children’s self-regulation is an important mediator of the association between parenting and externalizing behavior problems (Eisenberg, Sadovsky, et al., 2005). Indeed, in at least one previous study, the longitudinal paths from parenting to self-regulation to externalizing behavior problems were supported even after controlling for the stability in these variables over time (Eisenberg, Sadovsky, et al., 2005). Few previous studies of CE have examined the association between laboratory based behavioral measures of self-regulation and externalizing problems in the school setting, although some have noted direct associations between CE and laboratory measures of regulation of attention and arousal (Mayes et al., 1998) as well as frustration reactivity (Dennis et al., 2006). One explanation for the prospective but not cross-sectional association between self-regulation and externalizing problems may be that externalizing behaviors generally peak at about 2 to 3 years of age and decline thereafter (Campbell, 1995; Edwards et al., 2006; Nagin & Tremblay, 1999; Owens & Shaw, 2003). Thus, it may be more normative to exhibit these behaviors at younger ages,

but more maladaptive at kindergarten age. For this reason, self-regulation may not be associated with externalizing behavior problems cross-sectionally, but would be associated prospectively. That is, self-regulatory problems at 3 years increase risk for maladaptive externalizing behaviors in the school setting at kindergarten age. Other studies of parental substance use and externalizing behavior in kindergarten have also reported significant prospective associations between behavioral measures of self-regulation in the laboratory setting and externalizing behaviors in kindergarten (R. D. Eiden et al., 2007). Current results are supportive of the hypothesis that early self-regulatory difficulties serves as proximal mediator of the association between CE and children's externalizing behaviors, and they highlight the important role of harsh maternal behavior as an explanatory variable. Other results from longitudinal cohorts of cocaine-exposed children also indicate significant associations between CE and laboratory based measures of self-regulation (Bendersky, Gambini, Lastella, Bennett, & Lewis, 2003; Rose-Jacobs et al., 2009). Taken together, these previous studies and the current results suggest that poor self-regulation in the preschool years may be a critical predictor of a developmental trajectory for externalizing problems in the school setting. This is especially critical given other reports of high stability in externalizing behaviors beyond the early childhood years (Broidy et al., 2003). Thus, interventions targeted at reducing externalizing behaviors among these high risk children may ideally focus on the early childhood years in order to prevent a continuing trajectory of disruptive behaviors.

Contrary to expectations, gender did not moderate the association between CE and externalizing behavior. Results with regard to gender differences in externalizing behaviors have been mixed with some studies indicating that the association varies by child gender (Bailey et al., 2005; Delaney-Black et al., 2012; Sood et al., 2005), while others indicate no gender differences or moderation by gender. The current results are not supportive of studies indicating that the effects of CE on behavior problems were particularly salient for boys (e.g., Delaney-Black et al., 2004). However, previous studies reporting interactive associations between gender and prenatal substance exposure variables on externalizing behavior problems have been with older elementary school aged children (Bailey et al., 2005; Delaney-Black et al., 2004). In a review of a century's work on the study of aggression (Tremblay, 2000) observed that the normative trajectory of aggression is one that increases until 2–3 years of age, and then exhibits a sharp decline between 3–4 years of age. The small group of children who are persistently aggressive or defiant beyond this preschool period are at particularly high risk for developing greater psychopathology (Campbell, Spieker, Burchinal, Poe, & Network, 2006; Nagin & Tremblay, 1999). Thus, the potential effects of CE and externalizing behavior problems may begin to vary as a function of child gender at older ages. Another possibility is that there are gender differences in the extent to which children "mature out" of externalizing problems in general (Colder, Mott, & Berman, 2002) and in substance exposed samples of children (Edwards et al., 2006), resulting in more apparent gender differences at older ages. Future studies examining prospective changes in externalizing behavior problems from preschool to the school years may be better able to address this question. Previous reports of moderation by child gender also used measures of teacher reports of behavior problems (Bailey et al., 2005; Delaney-Black et al., 2004), but most studies have relied on parental reports of child behavior. Thus, results may

also vary by reporter and gender differences may be more apparent in the school context with greater demands for rule based behavior.

Results also highlighted the role of child exposure to community violence and child hunger as significant predictors of behavior problems in this sample. Results with regard the child exposure to violence are similar to those reported by Bada and colleagues (Bada et al., 2011) who reported significant associations between violence exposure and maternal but not teacher reports of behavior problems. It is possible that mothers who report higher child exposure to community violence are also more likely to observe and report externalizing problems in their children. The role of violence exposure and externalizing problems in early childhood may be especially critical given recent reports of the association between violence exposure and adolescent cocaine use among cocaine-exposed cohorts (Delaney-Black et al., 2011). Given current results, it is possible that one pathway to higher cocaine use among cocaine-exposed children is the externalizing pathway that begins to emerge in early childhood that is influenced by a variety of environmental risk factors including exposure to community violence.

Few studies of CE have examined the role of hunger. Results are supportive of previous studies indicating significant associations between food insecurity (a broader dimension of child hunger) and externalizing behavior problems (Melchior et al., 2009; Slopen et al., 2010). Some have argued that the association between food insecurity and externalizing behaviors is due to higher family stress, family chaos, or poor parenting (Huang et al., 2010). However, others have noted that the association between food insecurity and poor child physical and mental health remain significant even after accounting for general poverty (Slopen et al., 2010). The current results with regard to the unique association between hunger and school based externalizing behaviors are especially significant given that the majority of families were from low-income backgrounds and the model includes several sources of family stress. However, the association between hunger and externalizing problems were cross-sectional and it is unclear if hunger would be prospectively associated with externalizing behaviors beyond kindergarten. This is an area for future research.

This study has several limitations. First, accurate assessment of substance use both prenatally and postnatally is difficult. Pregnant and postpartum women are often hesitant to divulge substance use information, particularly illicit substances such as cocaine. One strength of this study is the use of multiple methods to ascertain prenatal substance use which partially mitigated this limitation even though the urine toxicology information was abstracted from medical records. A second important caveat of this study is that self-regulation was measured in the laboratory context and was limited to two measures of effortful control and observations of internalization. On the one hand, it is possible that the generalizability of these laboratory based measures is limited to this context. On the other hand, these are objective, observation based measures of self-regulation and do not have the method biases associated with maternal report measures of self-regulation. Further, these aspects of self-regulation in the preschool period are associated with disruptive behaviors in the school, thus lending further support to the importance of behavioral measures. A third issue is that generalizability is limited to a predominantly low -income, primarily African-American women and children. Moreover, results from attrition analyses indicated that 24%

of families had missing data at kindergarten age and there was some bias due to attrition. Although these variables were included as covariates in statistical modeling and we used full information maximum likelihood estimation, these results should be viewed in this context. Finally, several results were based on maternal report that may be subject to bias.

In spite of these limitations, the study fills an important gap in the literature on maternal cocaine use and externalizing behaviors, highlighting the role of maternal harshness and self-regulation as important intervening variables. Results suggest that interventions with this high risk sample of substance using mothers may focus on reducing harsh maternal behavior in the toddler years and promote maternal behavior that facilitates children's self-regulation in the preschool years. Doing so may have long lasting effects on children's disruptive behaviors in the home and school settings among these high risk children.

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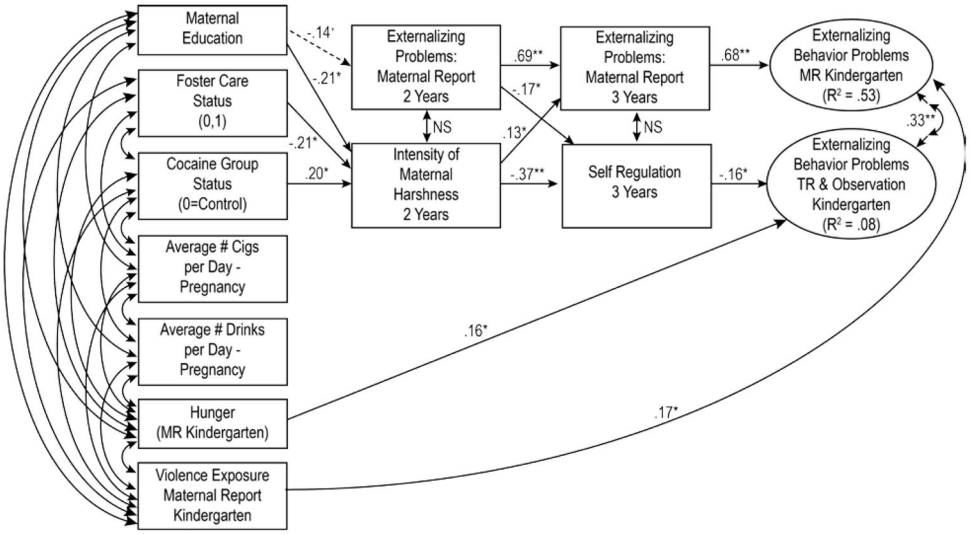

Figure 1.

The final indirect effects model. The model fit the data adequately, $\chi^2(116) = 140.65$, $p = .06$, comparative fit index = .98, root mean square error of approximation = .03, 95% CI [.00, .05], $n = 216$. The numbers represent standardized path coefficients. Non-significant path coefficients are not depicted in the model for ease of presentation. Covariances between exogenous variables are depicted in the figure but reported in Table 3. MR: Maternal report; TR: Teacher report. * $p < .05$, ** $p < .01$.

Table 1

Group Differences in Demographic Variables and Birth Outcomes

Exposure Group:	**Non-Cocaine *n* = 100**		**Cocaine *n* = 116**		***F* value**	**η_p^2**
	M	**SD**	**M**	**SD**		
Demographics:						
BM age	27.79	5.60	31.03	6.05	16.50**	.07
BM parity	3.17	1.64	4.16	2.42	12.50**	.05
Years education	12.02	1.88	11.64	1.91	2.12	.01
Occupational Status	3.38	1.83	2.78	1.32	7.92**	.04
Birth outcomes:						
Gestational age (weeks)	39.33	1.25	38.62	1.82	10.84**	.05
Birth weight (gms)	3334.45	503.78	2922.72	530.76	33.87**	.14
Birth length (cm)	48.13	3.06	49.96	2.90	20.08**	.09
Head circumference (cm)	33.61	1.38	33.08	2.06	4.77**	.02
OCS	100.81	17.30	85.30	16.34	45.83**	.18
Cigarettes/week	12.89	25.85	37.86	43.45	25.29**	.11
Drinks/week	.20	.82	3.72	11.27	9.74**	.04
Joints/week	.47	7.36	1.29	4.14	.05	.00
Days cocaine/week	0	0	.94	1.58	36.42**	.15

Note. BM: biological mother; OCS: Obstetrical complications scale score, high scores are more optimal. The means for child behavior problems reflect t scores. Occupational status was coded using Hollingshead (1957, 1975) scoring system. All of the substance use variables were assessed prenatally.

* $p < .05$

** $p < .01$

Table 2

Group Differences on Maternal and Child Behaviors

Exposure Group:	**Non-Cocaine**		**Cocaine**		***F* value**	**η^2**
	M	**SD**	**M**	**SD**		
Maternal Harshness	1.63	1.09	2.09	1.34	5.90**	.03
EC: Prize Delay	7.26	12.95	7.78	13.9	.06	.00
Internalization	4.16	1.50	4.05	1.56	.23	.00
EC: Snack Delay	3.05	1.31	3.05	1.22	.001	.00
Hunger	1.20	2.13	0.99	2.02	.42	.00
Violence Exposure	.30	.46	.36	.48	.52	.00
CBCLE: 2 Years	11.89	9.16	12.81	8.53	.46	.00
CBCLE: 3 Years	12.53	9.47	12.52	8.40	.00	.00
K Maternal Report:						
CBCLE	9.95	8.42	10.07	8.41	.01	.00
BASC-II PRS	22.80	14.81	21.57	12.22	.34	.00
SNAP-IV AD	3.27	3.12	3.20	3.12	.02	.00
SNAP-IV ODD	4.41	4.42	4.42	4.95	.00	.00
K Teacher Report and Observations						
BASC-II TRS	19.33	17.24	22.59	18.28	1.28	.01
SNAP-IV AD	1.93	2.57	2.98	3.73	3.90*	.03
SNAP-IV ODD	3.39	4.63	4.59	5.96	1.89	.01
BASC-II SOS	8.20	9.08	9.21	10.28	.41	.00

Note.

* $p < .05$,

** $p < .01$.

EC: Effortful Control, CBCLE: Externalizing Behavior Problems measured by the CBCL; K: Kindergarten; BASC-II PRS: Parent Rating Scale of the BASC-II; TRS: Teacher Rating Scale; AD: Aggression/Defiance; OD: Oppositional Defiant Disorder Symptoms; SOS: Student Observation System. Sample sizes for examining group differences ranged from 164 (*n* = 75 NCE, *n* = 89 CE) for K assessments to 177 (*n* = 83 NCE, *n* = 92 CE) for 2 year assessments.

Table 3

Correlations among variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Cocaine Group Status																		
2. # Cigarettes/week P	**0.33**																	
3. # Drinks/week P	**0.21**	**0.34**																
4. Years education	−0.10	**−0.22**	**−0.21**															
5. Foster Care Status	**0.42**	**0.22**	0.06	0.00														
6. Maternal Harshness	**0.18**	**0.16**	0.13	**−0.25**	−0.12													
7. Self-Regulation	−0.06	0.01	−0.11	**0.17**	0.04	**−0.40**												
8. Hunger (0=no hunger)	−0.09	0.12	0.02	−0.05	−0.04	0.06	−0.12											
9. Violence Exposure	0.06	0.06	−0.02	−0.05	0.12	0.04	−0.05	**0.17**										
10. CBCLE: 2 Years	0.05	0.06	−0.02	−0.12	−0.10	0.08	**−0.21**	0.11	0.09									
11. CBCLE: 3 Years	−0.00	0.08	−0.01	−0.13	−0.03	**0.21**	**−0.17**	**0.22**	**0.23**	**0.69**								
12. CBCLE: K	0.01	0.06	−0.03	−0.03	0.08	**0.17**	−0.14	**0.24**	**0.28**	**0.52**	**0.70**							
13. BASC-II PRS	−0.05	0.08	0.10	−0.09	0.03	0.15	−0.11	**0.21**	**0.27**	**0.45**	**0.66**	**0.74**						
14. SNAP-IV AD: Parent	0.01	0.08	−0.03	−0.08	0.00	0.15	−0.11	**0.25**	**0.28**	**0.40**	**0.58**	**0.79**	**0.59**					
15. SNAP-IV OD: Parent	0.00	0.09	−0.03	−0.07	0.00	0.15	−0.08	**0.20**	**0.30**	**0.40**	**0.55**	**0.80**	**0.65**	**0.88**				
16. BASC-II TRS	0.09	0.11	0.15	−0.05	0.06	**0.18**	**−0.32**	**0.22**	0.07	0.03	0.11	**0.30**	**0.36**	**0.29**	**0.30**			
17. SNAP-IV AD: Teacher	**0.16**	0.15	0.15	−0.01	0.01	**0.18**	**−0.18**	**0.17**	0.09	−0.05	0.09	**0.28**	**0.32**	**0.32**	**0.35**	**0.81**		
18. SNAP-IV OD: Teacher	0.11	0.13	0.13	−0.00	0.02	0.13	−0.15	**0.21**	0.13	−0.05	0.08	**0.27**	**0.30**	**0.30**	**0.34**	**0.84**	**0.94**	
19. BASC-II SOS	0.05	0.06	0.05	−0.00	0.06	0.14	**−0.19**	0.05	0.09	−0.02	−0.03	**0.17**	**0.29**	**0.18**	**0.20**	**0.49**	**0.50**	**0.48**

Note: #: Number, P: Pregnancy, CBCLE: Externalizing Behavior Problems measured by the CBCL; K: Kindergarten; BASC-II PRS: Parent Rating Scale of the BASC-II; TRS: Teacher Rating Scale; AD: Aggression/Defiance; OD: Oppositional Defiant Disorder Symptoms; SOS: Student Observation System. Numbers in bold reflect correlation coefficients were significant at $p < .05$. Coding for cocaine group status was 0 = control group and 1 = cocaine-exposed group. The sample sizes for correlations ranged from $n = 164$ to 216.