Externalizing Problems in Late Childhood as a Function of Prenatal Cocaine Exposure and Environmental Risk

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Objective To examine whether prenatal cocaine exposure (PCE) predicts externalizing problems in late childhood. **Methods** Externalizing problems were assessed using caregiver, teacher, and child ratings and a laboratory task when children ($N = 179$; 74 cocaine exposed) were aged 8–10 years. PCE, environmental risk, sex, neonatal health, other prenatal exposures, and foster care history were examined as predictors of externalizing problems. **Results** Multiple regression analyses indicated that PCE, environmental risk, and male sex explained significant variance in externalizing problems in late childhood. Models varied by source of information. PCE predicted externalizing problems for child laboratory behavior and interacted with sex because males with PCE reported more externalizing problems. PCE did not predict caregiver or teacher ratings of externalizing problems. **Conclusions** The effect of PCE on externalizing problems may persist into late childhood. The findings highlight the potential importance of including child-based measures of externalizing problems in studies of prenatal exposure.

Key words environmental risk; externalizing problems; prenatal cocaine exposure; sex differences.

Prenatal cocaine exposure (PCE) appears to be a risk factor for externalizing problems in early childhood. Animal studies suggest that PCE is related to greater aggression (Johns, Means, Woodley, Means, 1994; Wood & Spear, 1998), and several human studies have found PCE to predict increased externalizing problems in young children (e.g., Bada et al., 2011; Bendersky, Bennett, & Lewis, 2006; Delaney-Black et al., 2004; Linares et al., 2006; Minnes et al., 2010; Richardson, Goldschmidt, Leech, & Willford, 2011; Sood et al., 2005). Other studies, however, find no relation between PCE and externalizing problems (e.g., Accornero, Anthony, Morrow, Xue, & Bandstra, 2006; Bennett, Bendersky, & Lewis, 2002; Greenwald et al., 2011; Kilbride, Castor, & Fuger, 2006; Morrow et al., 2009), raising the question of whether PCE predicts externalizing problems only in the presence of certain moderators (e.g., male sex; environmental risk). Males, for example, have been found to be more vulnerable to the effects of PCE than females and exhibit more externalizing problems than unexposed males (Bendersky et al., 2006; Bennett, Bendersky, & Lewis, 2002, 2007, 2008; Carmody, Bennett, & Lewis, 2011; Delaney-Black et al., 2004).

The biosocial model proposes that both biological and environmental factors increase risk for the development of externalizing problems (Raine, 2002). Biological factors such as prenatal exposure to substances, neonatal medical problems, and male sex have been shown to increase risk for externalizing problems, as have environmental factors such as poverty, stress, maternal depression, and overreactive or lax parenting (Beck & Shaw, 2005; Bennett et al.,

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2002; Elgar, McGrath, Waschbusch, Stewart, & Curtis, 2004; Lahey et al., 2006; Lamborn, Mounts, Steinberg, & Dornbusch, 1991; Laucht et al., 2000; van den Akker, Dekovic, & Prinzie, 2010). Such environmental factors are often present in families of children with PCE and have been associated with poor outcomes, including externalizing problems, among cocaine-exposed children (Bendersky, Alessandri, Gilbert, & Lewis, 1996; Bendersky et al., 2006; Singer et al., 2008). Accordingly, it is important to consider environmental risk as a potential confounding variable not only at birth but also later in childhood when examining the relation between PCE and externalizing problems. Environmental risk also can be examined as a moderator of PCE effects as children with both prenatal exposure and high environmental risk may be at greatest risk for externalizing problems. Such moderator effects have been found in studies of developmental risk factors (e.g., Rutter, 1979; Simmons, Burgeson, Carlton-Ford, & Blyth, 1987) but have rarely been examined in the context of PCE.

PCE is associated with other risk factors as well that may confound any relation between PCE or environmental risk and externalizing problems. Children whose mothers prenatally use substances are more likely to enter foster care (Smith, Johnson, Pears, Fisher, & DeGarmo, 2007), and children with PCE who reside in foster or adoptive care have been found to exhibit more externalizing problems (Linares et al., 2006; Minnes et al., 2010). Prenatal alcohol (Paley, O'Conner, Kogan, & Findlay, 2005), tobacco (Day, Richardson, Goldschmidt, & Cornelius, 2000), and marijuana (Goldschmidt, Day, & Richardson, 2000) exposure, as well as neonatal medical problems (Raine, 2002) may also increase risk for externalizing problems and as such need to be examined as covariates when examining the effects of PCE and environmental risk.

Most studies of PCE have assessed externalizing problems using only one or two sources (e.g., caregiver or teacher ratings). Given the modest correlations typically found between sources when assessing externalizing problems (e.g., Achenbach, McConaughy, & Howell, 1987; Stanger & Lewis, 1993), researchers and clinicians alike are often faced with discrepant information. Such low agreement is likely due, in part, to children behaving differently across different contexts. Given that children who show elevated rates of externalizing problems across contexts are at the greatest risk for continuing problems in adolescence (Campbell, Shaw, & Gilliom, 2000), it is important to assess externalizing problems across multiple contexts. As such, we assessed externalizing problems using caregiver, teacher, child ratings and child laboratory performance, and examined predictors of externalizing problems for both individual sources and a composite measure across sources.

Few studies have examined the effects of PCE on externalizing problems during late childhood. Preadolescence is an important developmental period to examine externalizing problems, as children are more susceptible to peer influences (Steinberg & Monahan, 2007) and exhibit increased risk-taking behavior (Steinberg, 2004). Moreover, externalizing problems become increasingly stable in late childhood, and such problems predict violence and substance use in adolescence and adulthood (e.g., Dishion, Capaldi, & Yoerger, 1999; Loeber & Hay, 1997). We examined the effects of PCE on externalizing problems in a cohort of children aged 8–10 years while (a) accounting for the effects of prenatal exposure to alcohol, cigarettes, and marijuana; neonatal health; environmental risk; foster care history; and child sex; (b) examining environmental risk and sex as moderators of PCE effects; and (c) using caregiver, teacher, and child data to provide a comprehensive assessment of externalizing problems. We hypothesized that PCE, as well as environmental risk and male sex, would predict greater externalizing problems.

Methods

Participants

Participants were 179 children (89 boys, 90 girls; 41% with PCE) and their mothers from a longitudinal study on the developmental effects of prenatal substance exposure. Pregnant women residing in urban areas with a high prevalence of cocaine use who were attending hospital-based prenatal clinics or who were newly delivered in the three hospitals in Trenton, NJ, or at the Medical College of Pennsylvania in Philadelphia were approached. Of these, 82% agreed to participate, with 258 children seen at 4 months. Children born before 32 weeks, who required special care or oxygen therapy for >24 hours, exhibited congenital anomalies, were exposed to opiates or phencyclidine (PCP) *in utero*, or whose mothers were HIV+ were excluded. Mothers were predominantly African-American (87%), with 9% Caucasian and 3% Hispanic. Mothers' median education level was 11th grade ($SD = 1.6$), and 63% received Aid for Dependent Children. Children with externalizing problem data available from at least two of the three data sources (caregiver, teacher, or self) were included in the current report. There were no significant differences ($p > .10$) between participants seen versus not seen at the current follow-up on cocaine, alcohol, cigarette, or marijuana exposure; neonatal health; sex; maternal life stress; or public assistance status.

Procedure

The Institutional Review Boards of Drexel University College of Medicine and Robert Wood Johnson Medical Schoo approved the following procedures. At age 8 years, children participated in a laboratory measure of aggression (Pelham et al., 1991). At age 10 years, they completed a self-report, whereas caregivers completed questionnaires assessing their child's externalizing problems. Teachers completed measures of children's externalizing problems at the end of the third, forth, and fifth grade school years.

Measures

Prenatal Substance Use

Substance use information was obtained from a semi-structured interview within 2 weeks of birth. PCE was confirmed by analysis of newborns' meconium, which was screened with radioimmunoassay followed by confirmatory gas chromatography–mass spectrometry for the presence of benzoylecgonine (cocaine metabolite), cannabinoids, opiates, amphetamines, and PCP. Mothers showed no signs of PCP, heroin, or methadone use as determined by assay and by self-report. The mean amount of alcohol, cigarettes, marijuana, and cocaine used throughout pregnancy was assessed. To reduce skew, substance use was categorized as follows: alcohol (0 = 0 drinks/day, 1 = from 0.01 to 1.00/day, 2 = from 1.01 to 2.00/day, 3 = from 2.01 to 3.00/day, 4 = >3.00/day); cigarettes (0 = 0 cigarettes/day, 1 = from 0.01 to 1.00/day, 2 = from 1.01 to 5.00/day, 3 = from 5.01 to 10.00/day, 4 = >10.00/day); and marijuana (0 = 0 joints/day, 1 = from 0.01 to 0.50/day, 2 = from 0.51 to 1.00/day, 3 = >1.00/day). We transformed these ordinal-level alcohol, cigarette, and marijuana use scores using natural logarithms to further reduce skew for all analyses other than those in Table I, which lists means before recoding and transformation. PCE was dichotomized (i.e., into unexposed and exposed groups; 0 vs. 1) in all analyses, as prior reports from this sample have found the dichotomous measure to best predict outcomes (e.g., Bennett et al., 2007, 2008).

Neonatal Health

Neonatal medical problems were abstracted by nurses from hospital records at birth (Hobel, Hyvarinen, Okada, & Oh, 1973) and were log transformed to correct for skew. The mean of the transformed neonatal medical problems (lack of problems = higher score), gestational age, and birth weight standardized scores were used to measure neonatal health, with higher scores indicating better health (Cronbach's alpha = .77).

Environmental Risk

Environmental risk was assessed from caregiver report at birth, 4, 6, and 7 years. The environmental risk score at birth was based on the standardized means of maternal life stress (Social Environment Inventory; Orr, James, & Casper, 1992) and public assistance status (dichotomous variable; public assistance as main source of income = higher risk). Environmental risk during middle childhood was based on the standardized means of: maternal life stress, public assistance status, maternal depressive symptoms (Beck Depression Inventory; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), parental overreactivity, and parental laxness subscales (Steele, Nesbitt-Daly, Daniel, & Forehand, 2005) from the Parenting Scale (Arnold, O'Leary, Wolff, & Acker, 1993) (Cronbach's alpha = .60). Such composite scores are more stable than any individual measure, and there is increased power to detect effects of the environment because errors of measurement decrease, as scores are summed and degrees of freedom are preserved (Burchinal, Roberts, Hooper, & Zeisel, 2000; Wachs, 1991). This and similar cumulative environmental risk measures have been found to explain more variance in children's outcomes including externalizing problems than single factors (e.g., Atzaba-Poria, Pike, & Deater-Deckard, 2004; Bendersky & Lewis, 1994; Deater-Deckard, Dodge, Bates, & Pettit, 1998; Sameroff, Seifer, Baldwin, & Baldwin, 1993).

Foster Care History

Foster care history (0 = no history; 1 = child had resided in kinship care or with a long-term foster care provider) was assessed by caregiver report at age 10 years.

Externalizing Problems

Antisocial Behavior Subtyping Scale. Caregivers completed the Antisocial Behavior Subtyping Scale (ABSS) (Brown, Atkins, Osborne, & Milnamow, 1996) at age 10 years, and teachers completed it at the end of the third, forth, and fifth grade year. This 25-item scale (0 = *never*, 1 = *sometimes*, 2 = *very often*) contains a 6-item reactive factor (e.g., ''gets mad when corrected''), 10-item proactive factor (e.g., ''has hurt others to win a game/contest''), and nine filler items. Confirmatory factor analysis failed to replicate a two-factor solution, favoring a one-factor solution in the current sample for teacher ratings (CFI = .99, RMSEA = .02). Thus, the proactive and reactive items were summed into a total externalizing score. Cronbach's alpha for caregivers' total score was .89; the median alpha for teachers was .96.

Table I. *Means (and Standard Deviations) of Predictor and Outcome Variables*

	Cocaine exposed		Unexposed		
	Boys ($n = 33$)	Girls ($n = 41$)	Boys ($n = 56$)	Girls ($n = 49$)	$F(3,176)$
Predictor variables	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	
Neonatal health	−0.21 (0.90)[abd]	−0.61 (1.18)[b]	0.48 (0.53)[c]	0.21 (0.89)[d]	13.44***
Environmental risk (birth)	−0.07 (0.95)	0.24 (0.98)	−0.18 (1.13)	0.02 (0.85)	1.45
Environmental risk (4–7)	0.13 (1.09)	0.02 (1.05)	−0.12 (1.05)	−0.12 (0.82)	0.48
Foster care history	0.18 (0.35)[ab]	0.37 (0.46)[a]	0.06 (0.23)[b]	0.00 (0.02)[b]	13.06***
Prenatal substance exposure					
Cocaine (g/day)	0.50 (0.60)[a]	0.73 (0.92)[a]	0.00 (0.00)[b]	0.00 (0.00)[b]	23.16***
Alcohol (drinks/day)	1.10 (1.68)[ab]	1.93 (3.73)[a]	0.03 (0.17)[b]	0.02 (0.07)[b]	10.33***
Cigarettes (per day)	7.25 (7.40)[a]	10.10 (10.22)[a]	1.67 (5.12)[b]	1.41 (3.65)[b]	17.85***
Marijuana (joints/day)	0.13 (0.28)[ab]	0.56 (1.87)[a]	0.04 (0.27)[ab]	0.01 (0.03)[b]	3.34*
Externalizing problems (Z scores)					
Composite	0.46 (0.63)[a]	−.08 (0.49)[b]	0.00 (0.59)[b]	−0.26 (0.57)[b]	10.81***
Caregiver rating	0.37 (0.93)[a]	0.10 (0.87)[ab]	−0.10 (0.81)[ab]	−0.21 (1.08)[b]	2.75*
Teacher rating	0.46 (1.03)[a]	−0.10 (0.86)[ab]	0.02 (1.03)[ab]	−0.23 (0.94)[b]	3.47*
Child rating	0.50 (1.29)[a]	−0.17 (0.89)[b]	−0.01 (0.99)[ab]	−0.18 (0.78)[b]	3.81**
Peer competition task	0.50 (0.92)[a]	−0.04 (0.93)[ab]	0.10 (0.96)[a]	−0.41 (1.00)[b]	6.25***

[abcd]Different superscripts indicate that the group means differ significantly ($p < .05$, Scheffe post hoc analyses).
***$p < .001$, **$p < .01$, *$p < .05$.

Reactive-Proactive Aggression Scale. Caregivers completed the Reactive-Proactive Aggression Scale (RPAS) (Dodge & Coie, 1987) at age 10 years, and teachers completed it at the end of third, forth, and fifth grade. The 6-item measure (1 = *never*, 5 = *almost always*) contains a 3-item reactive (e.g., ''overacts angrily to accidents'') and a 3-item proactive (e.g., ''threatens and bullies others'') aggression subscale. As with the ABSS, a confirmatory factor analysis of teacher ratings failed to replicate a two-factor solution, favoring a one-factor solution (teacher ratings: CFI = .98, RMSEA = .08). Thus, the six items were summed into a total externalizing score. Cronbach's alpha for caregivers was .83; the median alpha for teachers was .94.

Laboratory Task. To provide a behavioral measure of externalizing problems, children completed a computer reaction-time game against a phantom peer who was allegedly in another room and were told that whoever has the most points at the end of the game wins a prize (Pelham et al., 1991). The ''peer'' is a computer program that takes away points in a standardized manner. For each of the 48 trials, the winner not only earns points but also can take away points from the other player. Externalizing problems were defined as the number of points the child took away from the peer following a ''Provocation trial'' (i.e., trials in which the peer took away points). Children with diagnoses of conduct disorder, oppositional defiant disorder, and ADHD have been found to take away more points and to be angrier during this task (Waschbusch et al., 2002). Teacher ratings of aggression have also been significantly correlated with the number of points taken away (Giancola, Martin, Tarter, Pelham, & Moss, 1996).

Self-Report of Delinquency Scale. Children completed a 10-item measure (1 = *never*, 4 = *often*) of delinquent behaviors at age 10 years. The Self-Report of Delinquency Scale (SRDS) was based on delinquency and school misconduct scales used by Steinberg, Lamborn, Darling, Mounts, & Dornbusch (1994) and adapted from questionnaires by Ruggiero (1984) and Gold (1970). Cronbach's alpha was .71.

Externalizing Problems Composite. Given the modest agreement typically found among sources (Achenbach et al., 1987) and the importance of sampling across contexts to identify children at greatest risk for future problems (Campbell, Shaw, & Gilliom, 2000), we constructed an externalizing problems composite using all four sources. First, though, a caregiver composite was created by computing the mean of standardized ABSS and RPAS scores (Cronbach's alpha = .86). The teacher composite was similarly constructed by computing the mean of standardized ABSS and RPAS scores for the third, forth, and fifth grade ratings (Cronbach's alpha = .93 across the six scores). Teacher ratings were significantly correlated across grades for both individual measures ($r = .68$ to .74; $p < .001$). Given the modest relation between children's ratings on the SRDS and the laboratory task, these measures were examined separately rather than used to form a child composite. An overall externalizing problems

composite was created by taking the mean of the standardized caregiver composite, teacher composite, child rating, and child laboratory task behavior scores.

Results

First, we provide descriptive information for the sample, followed by bivariate correlations between study variables and hierarchical regressions that examine the effects of PCE on externalizing problems when controlling for other risk factors. For the regression analyses, we entered early childhood variables in steps 1 and 2. Prenatal exposures to alcohol, cigarettes, and marijuana, and neonatal health, which may be affected by prenatal exposures, were entered in step 1. Perinatal environmental risk was entered in step 2 to see whether it contributed significant variance to externalizing problems beyond that contributed by the exposure and health variables in step 1. Environmental risk during middle childhood was entered in step 3 along with foster care history to see whether they contributed significant variance beyond that from environmental risk at birth. Sex was entered in step 4 so that it was controlled for when PCE was entered in step 5. The interactions of PCE with both sex and environmental risk at birth were entered in step 6 to see whether they added significant variance beyond that of the previously entered main effects. Missing data (2.7% of data) were managed by multiple imputation of 20 data sets containing all study variables in SPSS version 19 (IBM, Armonk, New York).

Table I presents means and standard deviations as a function of PCE and sex for each study variable. One-way 2 (PCE) × 2 (sex) ANOVAs indicated that boys with PCE had more externalizing problems than unexposed boys, as well as both groups of girls on the composite measure. Exposed, but not unexposed, boys also had more externalizing problems than unexposed girls as rated by caregivers, teachers, and themselves. Exposed and unexposed groups were well matched on environmental risk, but girls with PCE had poorer neonatal health, more foster care, and their mothers drank more alcohol than those of unexposed children, while using more marijuana than mothers of unexposed girls. Mothers of children with PCE also smoked more cigarettes during pregnancy.

Table II presents correlations between study variables. PCE was associated with greater externalizing problems on the composite, caregiver ratings, and the laboratory task. Alcohol exposure also was associated with greater externalizing problems on the composite and child ratings. Cigarette exposure, marijuana exposure, and neonatal health were unrelated to each measure of externalizing problems. Male sex was associated with great externalizing problems on all measures other than caregiver ratings. Environmental risk at birth and middle childhood were both associated with greater externalizing problems on the composite and teacher ratings, whereas environmental risk in middle childhood was associated with greater externalizing problems as rated by caregivers. In contrast, foster care history was unrelated to each externalizing problems outcome.

PCE and Environmental Risk as Predictors of Externalizing Problems When Controlling for Other Risk Factors

Table III presents the standardized regression coefficients at time of entry and for the final equation, change in R^2 for each block, and total model R^2 for the prediction of externalizing problems. The total model significantly predicted children's externalizing problems, explaining between 12 and 24% of the variance ($p < .05$).

PCE as a Predictor of Externalizing Problems

PCE predicted greater externalizing problems as assessed by the composite measure ($\beta = .22$, $p = .04$). We next examined each of the four individual externalizing problem measures (see Table III). PCE predicted the taking of a greater number of points from the phantom peer during the laboratory task ($\beta = .26$, $p = .02$), but did not predict child, caregiver, or teacher ratings of externalizing problems when examining main effects.

Sex as a Moderator of PCE Effects on Externalizing Problems

The interaction of PCE and sex predicted child ratings of externalizing problems, as exposed males reported the most externalizing problems ($\beta = -.15$, $p = .04$). Sex, however, did not moderate the relationship between PCE and externalizing problems as assessed by child laboratory task, caregiver ratings, or teacher ratings.

Environmental Risk as a Predictor of Externalizing Problems

As hypothesized, environmental risk at birth ($\beta = .20$, $p = .01$) and environmental risk during middle childhood ($\beta = .20$, $p = .02$) each predicted greater externalizing problems as assessed by the composite measure. Examining specific measures, environmental risk at birth predicted teacher ratings, but not child measures or caregiver ratings, of externalizing problems and only at the time of initial entry ($\beta = .19$, $p = .02$). In contrast, environmental risk during middle childhood predicted greater externalizing problems as rated by caregivers ($\beta = .32$, $p < .001$).

Table II. *Correlations Among Predictors and Externalizing Problems*

Study variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Predictor variables														
1. Neonatal health	–													
2. Prenatal alcohol exposure[a]	.10	–												
3. Prenatal cigarette exposure[a]	0.19**	.45***	–											
4. Prenatal marijuana exposure[a]	.01	.40***	.37***	–										
5. Environmental risk (birth)	.01	−.04	.04	−.13	–									
6. Environmental risk (4–7 years)	0.11	−.04	.22**	−.08	.42***	–								
7. Foster care history (0 = no, 1 = yes)	0.16*	.31***	.36***	.25***	.05	.05	–							
8. Sex (0 = girl, 1 = boy)	−.02	−.03	−.09	−.05	.01	.02	−.10	–						
9. Prenatal cocaine exposure (0 = no, 1 = yes)	.22**	.62***	.59***	.38***	.12	.13^	.40***	−.09	–					
Externalizing problems														
10. Caregiver rating	.09	.08	.06	.11	.12	.29***	.09	.09	.17*	–				
11. Teacher rating	.03	.11	.02	.08	.17*	.17*	.03	.18*	0.14^	.46***	–			
12. Child rating	.07	.21**	.04	−.04	.05	.03	.10	.19**	0.11	.27***	.22**	–		
13. Laboratory task	.00	.13^	.00	.10	.12	.06	−.08	.25***	.17*	.15*	.08	.04	–	
14. Composite	.07	.21**	.05	.09	.18*	.21**	.06	.28***	.23**	.72***	.69***	.61***	.51***	–

Note. All correlations are Pearson correlations with the exception of those involving dichotomous variables (foster care history; child sex; prenatal cocaine exposure), which are Spearman correlations.

[a]Prenatal alcohol, cigarette, and marijuana correlations are based on the log-transformed variables described in the Methods section.

***$p < .001$, **$p < .01$, *$p < .05$, ^$p < .10$.

Environmental Risk as a Moderator of PCE Effects on Externalizing Problems

The interaction of PCE and environmental risk was not significant for any variable.

Other Predictors of Externalizing Problems

Prenatal alcohol exposure predicted greater child ratings of externalizing problems ($\beta = .29$, $p = .001$), whereas marijuana exposure surprisingly predicted fewer child rated externalizing problems in the final regression model ($\beta = -.18$, $p = .04$). Male sex was associated with greater taking of points during the laboratory task ($\beta = .24$, $p = .001$), child ratings ($\beta = .19$, $p = .01$), and teacher ratings ($\beta = .19$, $p = .01$), but was not associated with caregiver ratings of externalizing problems. Neonatal health, prenatal cigarette exposure, and foster care history did not significantly predict any measure of externalizing problems.

Discussion

The current findings indicate that PCE may predict greater risk for externalizing problems in late childhood. The relation between PCE and our composite measure of externalizing problems was found after controlling for neonatal health, other prenatal exposures, environmental risk, foster care history, and sex, each of which has previously been associated with increased risk for externalizing problems. Models, however, varied by source of information as PCE predicted externalizing problems for child ratings and child laboratory behavior, but not for caregiver or teacher ratings.

The relation between PCE and externalizing problems has been inconsistent across as well as within studies. Of note, most studies have relied on caregiver report and, in particular, the Child Behavior Checklist (Achenbach & Rescorla, 2001) to assess externalizing problems. In the present study, although PCE predicted a composite measure of externalizing problems based on child laboratory task and child, caregiver, and teacher ratings, examination of each source indicated that PCE reached significance as a predictor only for the child-based measures. A main effect was found for PCE to predict higher scores on the laboratory task, as children with PCE took away more points from a phantom peer, whereas a PCE by sex interaction was found for child ratings. Cocaine-exposed males, but not females, reported greater externalizing problems on self-report, consistent with some prior research finding PCE to be associated with greater risks for boys than girls (Bendersky et al., 2006; Bennett et al., 2002, 2007, 2008; Carmody et al., 2011; Delaney-Black et al., 2004). In an earlier report of this sample at age 5 years, we also found PCE to predict an externalizing problems composite (Bendersky et al., 2006). Also similar to the current findings, PCE predicted child but not caregiver or teacher ratings at age 5 years. In addition, PCE failed to predict caregiver ratings of externalizing problems using the Child Behavior Checklist at age 4 years in the current sample (Bennett et al., 2002).

Table III. *Hierarchical Regressions Predicting Externalizing Problems at Age 8–10 Years*

	Predictor														
	Composite					Child laboratory task					Child rating				
	Entry statistics		Final statistics			Entry statistics		Final statistics			Entry statistics		Final statistics		
	b (SE b)	β	b (SE b)	β	ΔR^2	b (SE b)	β	b (SE b)	β	ΔR^2	b (SE b)	β	b (SE b)	β	ΔR^2
Neonatal health	.00 (.06)	.01	.00 (.06)	.00	.05^	.05 (.10)	.04	.05 (.10)	.04	.03	.08 (.09)	.06	.07 (.10)	.06	.07**
Prenatal alcohol exposure	.14 (.05)	.23**	.09 (.06)	.14		.14 (.09)	.14^	.06 (.10)	.06		.29 (.09)	.29**	.24 (.10)	.24*	
Prenatal cigarette exposure	−.03 (.05)	−.05	−.09 (.06)	−.14		−.08 (.09)	−.08	−.13 (.10)	−.13		−.02 (.08)	−.02	−.01 (.10)	−.01	
Prenatal marijuana exposure	.01 (.05)	.02	.01 (.05)	.02		.07 (.08)	.07	.08 (.09)	.08		−.14 (.08)	−.14^	−.18 (.09)	−.18*	
Environmental risk (birth)	.12 (.05)	. 20**	.05 (.06)	.08	.04**	.14 (.08)	.14^	.10 (.09)	.10	.02^	.03 (.08)	.03	.01 (.10)	.01	.00
Environmental risk (4–7 years)	.19 (.08)	.20*	.18 (.08)	.19*	.03*	.06 (.13)	.04	.03 (.13)	.02	.02	.04 (.14)	.03	.04 (.13)	.03	.01
Foster care history (0 = no,1 = yes)	−.01 (.05)	−.01	.01 (.05)	.01		−.14 (.08)	−.14^	−.15 (.08)	−.15^		.08 (.08)	.08	.12 (.08)	.12	
Sex (0 = girl, 1 = boy)	−.18 (.04)	−.28***	−.18 (.04)	−.30***	.08***	−.24 (.07)	−.24***	−.24 (.07)	−.24***	.06***	−.19 (.07)	−.19**	−.21 (.07)	−.20**	.04**
Prenatal cocaine exposure (0 = no, 1 = yes)	.13 (.07)	.22*	.13 (.07)	.22*	.02*	.26 (.11)	.26*	.26 (.11)	.26*	.03*	.04 (.11)	.04	.03 (.11)	.03	.00
Cocaine exposure X sex	−.07 (.04)	−.11	−.07 (.04)	−.11	.03^	.02 (.07)	.02	.02 (.07)	.02	.00	−.15 (.07)	−.15*	−.15 (.07)	−.15*	.04*
Cocaine exposure X environmental risk (birth)	−.08 (.05)	−.12	−.08 (.05)	−.12		−.01 (.09)	−.01	−.01 (.09)	−.01		−.15 (.09)	−.15^	−.15 (.09)	−.15^	
Total model R^2					.24***					.15**					.15**

	Caregiver rating					Teacher rating				
	Entry statistics		Final statistics		ΔR^2	Entry statistics		Final statistics		ΔR^2
	b (SE b)	β	b (SE b)	β		b (SE b)	β	b (SE b)	β	
Neonatal health	−.07 (.09)	−.07	−.06 (.09)	−.05	.02	−.03 (.10)	−.03	−.06 (.10)	−.05	.01
Prenatal alcohol exposure	.03 (.08)	.03	−.01 (.09)	−.01		.10 (.09)	.10	.06 (.10)	.06	
Prenatal cigarette exposure	.01 (.08)	.01	−.12 (.09)	−.13		−.04 (.09)	−.04	−.09 (.10)	−.10	
Prenatal marijuana exposure	.07 (.08)	.08	.08 (.08)	.09		.05 (.08)	.05	.06 (.09)	.06	
Environmental risk (birth)	.13 (.08)	.14^	−.02 (.08)	−.02	.02^	.19 (.08)	.19*	.12 (.09)	.12	.04**
Environmental risk (4–7 years)	.45 (.12)	.32***	.45 (.12)	.32***	.08***	.22 (.13)	.14^	.21 (.13)	.14	.02
Foster care history (0 = no, 1 = yes)	.04 (.07)	.05	.05 (.07)	.05		−.01 (.08)	−.01	.01 (.08)	.01	
Sex (0 = girl, 1 = boy)	−.09 (.07)	−.10	−.09 (.07)	−.10	.01	−.18 (.07)	−.19**	−.19 (.07)	−.20**	.03**
Prenatal cocaine exposure (0 = no, 1 = yes)	.14 (.10)	.15	.14 (.10)	.15	.01	.10 (.11)	.10	.10 (.11)	.10	.00
Cocaine exposure X sex	−.07 (.07)	−.07	−.07 (.07)	−.07	.01	−.08 (.07)	−.08	−.08 (.07)	−.08	.01
Cocaine exposure X environmental risk (birth)	−.06 (.08)	−.07	−.06 (.08)	−.07		−.08 (.09)	−.08	−.08 (.09)	−.08	
Total model R^2					.14**					.12*

^ $p \leq .10$, * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

These findings suggest that child measures of externalizing problems are important to include in studies of prenatal substance exposure because inclusion of only caregiver or teacher ratings may obscure potential relations between PCE and later externalizing problems. Child-based measures may be particularly important to include when children enter late childhood and early adolescence. During this age period, children tend to exhibit less overt externalizing behaviors (e.g., physical aggression), whereas covert externalizing behaviors (e.g., stealing, truancy) stay at previous levels or may increase (Patterson, Shaw, Snyder, & Yoerger, 2005; Patterson & Yoerger, 1999). Children are more likely to report on their covert externalizing behavior such as that assessed in the current study than are adults, who may be unaware of such behavior (De Los Reyes & Kazdin, 2005; Karver, 2006). Thus, although it is unclear whether PCE would predict a broader measure of externalizing problems than what we used, inclusion of child-based measures may produce a more valid measure by which to examine relations between PCE and externalizing problems for children in this and older age groups.

The direct effect of environmental risk in middle childhood, but not at birth, on the composite measure of externalizing problems was largely owing to caregiver ratings. This relation for caregiver ratings is consistent with research indicating that proximal effects have a greater impact on development than more distal effects (Flouri & Tzavidis, 2008; Lewis, 1997). Environmental risk, however, did not moderate the effects of PCE on externalizing problems as only main effects of environmental risk were significant. This is consistent with earlier findings predicting child externalizing problems at age 4 years in this sample (Bennett et al., 2002) and suggests that the effects of PCE and environmental risk are additive rather than multiplicative on children's externalizing problems.

The specific process by which environmental risk may lead to increased externalizing problems is likely multidetermined. Family stress, for example, has been related to greater use of negative parental control and, subsequently, child externalizing problems (Campbell, Pierce, Moore, Marakovitz, & Newby, 1996). Poverty increases risk for parental depression, harsh parenting, and a chaotic family environment, all of which are risk factors for externalizing problems (Dearing, 2008; Lovejoy, Graczyk, O'Hare, & Neuman, 2000). Parental stress, low SES, and parental psychopathology also have been shown to impact youths' regulatory functioning (e.g., Accornero, Morrow, Bandstra, Johnson, & Anthony, 2002; Singer et al., 2002), which in turn increases risk of developing externalizing problems (Gardner, Dishion, & Connell, 2008).

Limitations of the current study deserve mention. First, this study was conducted with an urban, predominantly African American sample, and as such the findings do not necessarily generalize to other populations. Second, our measures of environmental risk at birth and during middle childhood differed somewhat, with maternal depressive symptoms and parenting dimensions assessed only during middle childhood. In addition, other environmental risk factors that were not assessed (e.g., violence exposure; maltreatment) may also affect the development of externalizing problems. Third, although laboratory measures of aggression such as the peer competition task used in the current study offer the advantage of providing a controlled and objective assessment of behavior and have shown evidence of external validity (Anderson & Bushman, 1997), more validation is needed to clearly demonstrate that the peer competition task is a measure of externalizing behavior as opposed to related constructs, such as competitiveness (Ritter & Eslea, 2005).

In summary, this study contributes to the literature on externalizing problems by examining the effects of both PCE and environmental risk in late childhood, as prior studies generally examine PCE effects on externalizing problems at younger ages. Our findings suggest that the negative effects of PCE may continue into late childhood, which is concerning, given that externalizing problems at this age are moderately good predictors of antisocial behavior and substance use during adolescence (King, Iacono, & McGue, 2004; Loeber & Hay, 1997). It remains to be seen whether PCE affects externalizing problems during adolescence and adulthood or dissipates, given that proximal environmental factors may obscure the effects of PCE. Moreover, PCE did not predict caregiver and teacher ratings of externalizing problems. Although children's behavior varies by context and raters each have unique perspectives (Dirks, De Los Reyes, Briggs-Gowan, Cella, & Wakschlag, 2012), the lack of a PCE effect on caregiver and teacher ratings suggests some degree of resiliency for children with PCE.

Clinically, increased screening for PCE history, as well as environmental risk factors such as parental depressive symptoms, financial hardship, harsh and lax parenting, and externalizing problems themselves by pediatricians and other community providers may lead to earlier identification of children at risk for externalizing problems. Referrals for interventions that treat parents' depressive symptoms, assist with alleviating poverty, and directly teach parenting skills aimed at reducing young children's externalizing problems (e.g., Dearing, 2008; Frazier, Cappella, & Atkins, 2007; Sanders & McFarland, 2000;

Van Zeijl et al., 2006) may help to provide families with the resources necessary to minimize the potential negative impact of PCE and environmental risk factors on children's development.

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