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Prenatal Cocaine Exposure: A Comparison of 2-Year-Old Children in Parental and Nonparental Care

Josephine V. Brown, Roger Bakeman, Claire D. Coles, Kathleen A. Platzman, and Mary Ellen Lynch

Effects of prenatal cocaine exposure and parental versus nonparental care on outcome at 2 years of age were examined. The sample included 83 cocaine-exposed and 63 nonexposed children and their caregivers; 49 and 34 of the cocaine-exposed children experienced parental and nonparental care, respectively. Prenatal drug exposure was not related directly to children's outcome at 2 years of age. However, compared with cocaine-exposed children in parental care, those in nonparental care experienced a more optimal environment and performed better in several developmental domains at 2 years of age in spite of being at greater neonatal risk. Further analyses suggested that this protective effect of nonparental care was in part due to nonkin rather than kin care.

The physical, cognitive, social, and emotional status of young children born to women who used cocaine during pregnancy has been a matter of concern since the epidemic of cocaine and crack use that began in the 1980s. (Women who use cocaine generally also use other substances such as marijuana, alcohol, and tobacco. Thus, *cocaine-polydrug*, rather than *cocaine*, is the more accurate term. However, for the sake of brevity, we refer to cocaine exposure when cocaine-polydrug exposure would be more accurate.) Most initial research focused on the potentially teratogenic effect of prenatal cocaine exposure; therefore, when reporting any direct effects, investigators typically controlled for socioeconomic, perinatal, and postnatal variation. Identification of teratogenic effects, however, has been sufficiently unconvincing (for a recent review, see Frank, Augustyn, Knight, Pell, & Zuckerman, 2001) that leading researchers in the field now question whether a ''crack baby'' syndrome even exists (Frank et al., 2003). At the same time, several investigators have reported that the postnatal caregiving environment of young children with prenatal cocaine exposure is often compromised (e.g., Alessandri, Bendersky, & Lewis, 1998; Bendersky & Lewis, 1998; Eiden, Peterson, & Coleman, 1999; Platzman, Coles, Bard, Brown, & Lynch, 2001; Singer et al., 2002; Wasserman & Leventhal, 1993). For this reason, investigators have begun to ask whether apparent exposure effects might be due to a less optimal caregiving environment provided to cocaine-exposed infants (e.g., Frank et al., 2002; Hans, 2002; Hurt et al., 1996; Hurt et al., 1995; Kettinger, Nair, & Schuler, 2000; Swanson, Beckwith, & Howard, 2000).

The present study examined the importance of the postnatal caregiving environment for cocaine-exposed infants by taking advantage of a natural manipulation: Some cocaine-exposed infants continue to be cared for by their birth mothers but others become cared for by nonparents. Many women who use cocaine during pregnancy relinquish the care of their infants to others, either voluntarily or involuntarily. Indeed, the percentages of cocaine-exposed children in nonparental care can be considerable by the time they are 2 years of age, varying between 21% and 50% (e.g., Hurt et al., 1996; Hurt et al., 1995; Singer et al., 2002; Wasserman & Leventhal, 1993; see also Hans, 2002, for a review of the impact of drug use on parental care).

Results of the few studies that have examined whether type of care affects the development of cocaine-exposed young children have been inconsistent. Hurt and her colleagues evaluated the cognitive development of a cohort of low-income children with prenatal cocaine exposure between the ages of 6 months and 5 years (Hurt et al., 1996; Hurt et al., 1995; Hurt, Malmud, Betancourt, Brodsky, & Giannetta, 2001) and reported that children in nonparental care, compared with those in parental care, had lower cognitive scores at 18 months and at 3 years but did not differ at other ages. In contrast, Kilbride, Castor, Hoffman, and Fuger (2000) reported

Josephine V. Brown and Roger Bakeman, Department of Psychology, Georgia State University; Claire D. Coles, Kathleen A. Platzman, and Mary Ellen Lynch, Department of Psychiatry and Behavioral Sciences, Emory University School of Medicine.

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Correspondence concerning this article should be addressed to Roger Bakeman, Department of Psychology, Georgia State University, Atlanta, GA 30303. Electronic mail may be sent to bakeman@gsu.edu.

higher cognitive scores for 3-year-olds in nonparental care, and Singer et al. (1994) reported no differences. Introducing a potentially important distinction, Frank and her colleagues considered the differential impact of two types of nonmaternal care: kin and nonkin (Frank et al., 2002): Compared with children living with birth mothers, the adjusted Bayley (1969) Mental Development Index (MDI) scores (but not the Psychomotor Development Index [PDI] scores) of children in the care of family members was lower at 6 months but similar at 24 months, whereas the MDI of children in unrelated foster care was lower at 6 months but higher at 24 months. The results of this study suggest that nonparental care, especially nonkin care, may have a protective effect on the cognitive development of toddlers with prenatal cocaine exposure. With respect to social development, a few differences at 12 months but none at 24 months have been reported. Beeghly, Frank, Rose-Jacobs, Cabral, and Tronick (2003) reported that cocaine-exposed 12-month-old infants in nonparental care cried less than those in parental care during separation and reunion episodes but did not differ with respect to quality of attachment. Similarly, Rodning, Beckwith, and Howard (1991) and Swanson et al. (2000) found no effect on attachment at 15 months. Furthermore, Hurt et al. (1996) found no effects of type of care on play behavior of cocaine-exposed toddlers at 18 and 24 months, and Beckwith et al. (1994) reported no effects on the play behavior of 2-year-olds.

Even fewer studies have examined whether characteristics of birth mothers or their cocaine-exposed neonates vary by type of subsequent care, but these few suggest that women who later relinquish care of their infants may be at higher risk for nonoptimal parenting and their infants may be at higher risk for less optimal development. Thus, based on the same cohort, Beeghly et al. (2003) and Frank et al. (2002) reported that birth mothers of children in nonparental care were heavier cocaine users than those of infants in parental care, and Nair et al. (1997) reported that, in a cohort that included women who used cocaine or heroin during pregnancy as well as women who were HIV positive, mothers who relinquished the care of their infants reported more psychological problems at a 2-week follow-up visit, experienced a greater number of negative life events during the previous year, were more likely to have a history of incarceration, and their infants were more challenging (e.g., low birth weight, preterm, neonatal problems). However, other studies have not found differences in neonatal characteristics (Frank et al., 2002; Howard, Beckwith, Espinosa, & Tyler, 1995).

In this report, we focus on the cognitive and social-emotional outcome of 24-month old cocaine-exposed toddlers. By 2 years of age most children are in the process of individuation and gaining control over themselves and their environment; thus, it is an age when any protective effects of the early caregiving environment might be apparent. Additionally, effects of drug exposure might be expected for the social-emotional outcome. In contrast to studies that have employed growth or cognitive measures in early childhood, those employing measures related to problems of arousal, affect, or attention regulation in early infancy have been more consistent in finding associations with prenatal cocaine exposure (Alessandri, Sullivan, Imaizumi, & Lewis, 1993; Bard, Coles, Platzman, & Lynch, 2000; Bendersky & Lewis, 1998; Coles, Bard, Platzman, & Lynch, 1999; Mayes, Bornstein, Chawarska, Haynes, & Granger, 1996; Roumell, Wille, Abramson, & Delaney, 1997). In so far as arousal, affect, and attention regulation are considered to be antecedents of self-regulation (Kopp, 1982; Ruff & Rothbart, 1996), problems in these areas would predict that cocaine-exposed toddlers have more social-emotional problems than their nonexposed counterparts at 2 years of age. Based on these considerations and the literature cited, we developed four hypotheses. The first two compare mothers who did and did not use cocaine during pregnancy, and their children, and are intended to replicate findings already reported in the literature. The second two hypotheses compare cocaine-using parents who did and did not relinquish care and their toddlers' 24-month-old outcome.

First, in comparison with nonusers, we expected that women who used cocaine during pregnancy would be at increased socioeconomic and obstetric risk. Additionally, we expected their infants to experience a higher likelihood of nonparental care, greater involvement with child protective services, and a lower likelihood of contact with their birth parents at 2 years of age. Second, we expected that direct effects of cocaine exposure at 2 years of age would be domain specific. We expected no direct effects on physical growth or on cognitive or language development. However, because of problems with arousal and attention during early infancy, the potentially nonoptimal caregiving environment, and the current potentially turbulent developmental phase, we expected some direct effects on social-emotional behavior. Third, we expected that birth mothers who relinquished care of their cocaine-exposed infants, either voluntarily or involuntarily, would have been heavier cocaine users during pregnancy and would evidence greater socioeconomic

and obstetric risk compared with those who continued to care for their cocaine-exposed infants, and we expected that their infants would be at greater neonatal risk. Fourth, we expected that at 2 years of age the current caregiving environment, the social-emotional developmental outcome, and perhaps the cognitive-language outcome would be more positive for cocaine-exposed toddlers in nonparental care compared with those in parental care.

Method

Participants

Participants in this longitudinal study of the developmental effects of maternal cocaine abuse were 146 low-income, primarily African American women (94%) and their full-term and preterm infants, as well as nonparental caregivers. Mothers and infants were recruited between January 1992 and December 1994 following delivery at an urban hospital in Atlanta, Georgia, if they met the following inclusion criteria: (a) maternal age of at least 19 years; (b) no drug use during pregnancy other than cocaine, alcohol, tobacco, or marijuana; (c) adequate maternal health (e.g., no major medical conditions such as gestational diabetes and HIV infection); (d) adequate infant health (e.g., no major infections, no major surgery, less than 30 days on oxygen); and (e) mother English speaking.

At recruitment, several sources of data were used to identify maternal drug use: (a) maternal medical records, which frequently contained the results of urine screens during pregnancy and delivery; (b) maternal self-reports in the hospital using the Drug Checklist During Pregnancy (Coles, Platzman, Smith, James, & Falek, 1992); and (c) postpartum maternal and infant urine samples, which were analyzed for cocaine metabolites (enzyme-multiplied immunoassay technique [EMIT] assay). Perinatal urine samples were collected from 100% of the dyads in the user group and from 95% of the dyads in the nonuser group. Of the women who had been assigned to the cocaine user group ($n = 83$, many also used alcohol and tobacco, and some used marijuana), 70% had one or more positive urine screens; of those, 95% also reported cocaine use. The remaining 30% of mothers in the user group had been assigned on the basis of self-report. Of the women assigned to the nonuser group ($n = 66$, some used tobacco), 100% reported no cocaine use and this was corroborated in all of those who were screened ($n = 63$). The 3 nonusers without urine screens were excluded from our analyses, leaving 63 nonusers. Additionally, a group of 13 mothers who used alcohol but did not use cocaine or marijuana were not included in the cohort used for this report. As described subsequently, following the 24-month assessment, parents in the cocaine group were divided into two groups: (a) parents who continued to care for their own infants and (b) parents whose infants were cared for by nonparents. Percentages of birth mothers reporting use of cocaine, alcohol, tobacco, and marijuana use in the three groups are given in Table 1.

Table 1
Percentages of Birth Mothers Reporting Use of Various Drugs Prenatally

Drug	Group		
	Cocaine nonparental care ($n = 34$)	Cocaine parental care ($n = 49$)	Nonuser ($n = 63$)
Cocaine	100	100	0
Marijuana	35	27	0
Alcohol	59	55	0
Tobacco	91	86	15

Note. Cocaine use was determined by self-report, urine screen, or both, whereas use of other drugs was determined by self-report only; all nonusers had a negative urine screen.

Mothers and infants included in the present sample formed a subgroup of a larger cohort of 234 cocaine users and nonusers who had been recruited in the postnatal period (see Brown, Bakeman, Coles, Sexson, & Demi, 1998). Given the nature of the sample, we expected a relatively high attrition rate and initially selected a larger sample than we planned to follow. When the children were 2 years of age, 88 caregivers and their toddlers were lost to follow-up (38%) for the following reasons: the mothers withdrew (20), the infants died (5; all from the cocaine group), the families left the area (9), or the families could not be located or scheduled at 24 months (54). About half (52%) of the families dropped out early (before the 8-week follow-up visit). Cocaine users and nonusers did not differ in the rate of attrition, nor did those who dropped out differ significantly from those who completed the 24-month follow-up with respect to the maternal background or perinatal risk variables listed in Table 2.

Procedure

The infants and mothers were recruited in the hospital. Follow-up laboratory visits were scheduled at 8 weeks, 6 and 12 months, and 2 years postpartum; children were seen within 2 weeks of their target age. Additionally, outreach workers made home visits at

Table 2
Group Means and Percentages for Maternal Background, Perinatal Risk, and Parenting Risk Variables of Birth Parents

		Group							
		Cocaine non-parental care (NP) ($n = 34$)		Cocaine parental care (PC) ($n = 49$)		Nonuser (NU) ($n = 63$)		Contrast	
Variable	*N*	*M* or %	*SD*	*M* or %	*SD*	*M* or %	*SD*	Cocaine vs. NU	NP vs. PC
Maternal background									
Mother's age	146	28.9	(3.8)	30.4	(4.9)	26.2	(5.7)	0.32**	−0.10
Finished high school	145	48		43		65		0.77*	1.12
Income < $300/month	145	94		53		55		1.50**	3.70**
Never married	146	82		86		75		1.22	0.88
Obstetric risk									
No. of previous live births	146	2.6	(1.7)	2.7	(1.5)	1.9	(1.4)	0.24**	−0.02
Obstetric optimality	133	73.0	(11.8)	78.3	(8.5)	80.3	(10.8)	−0.22**	−0.19*
Gestational age	146	36.3	(3.2)	38.1	(2.7)	37.1	(3.2)	0.01	−0.22**
Prenatal care, first half	144	26		31		61		0.63**	0.89
Male	146	56		53		54		1.01	1.06
Parenting risk									
Relinquished care	146	100		0		3		3.12	—
No contact, birth mother	146	74		4		0		—	8.08**
No contact, birth father	146	88		29		13		2.28**	4.33**
Child protective services	146	82		27		6		2.67**	3.59**

Note. Means and standard deviations are given for continuous variables, and percentages are given for binary variables. Contrasts are ordinary least squares regression coefficients for continuous variables, partial odds ratios (e^B) from logistic regression for binary variables. Regression coefficients >0 and partial odds ratios >1 indicate cocaine (NP and PC combined) >NU, and cocaine NP >cocaine PC.
*$p < .05$. **$p < .01$.

1 week, 6 months, and 18 months postpartum. At follow-up, preterm infants were seen at ages that were corrected for prematurity. The parents or guardians, if appropriate, signed informed consent forms approved by the internal review boards at the Emory University School of Medicine, Georgia State University, and Grady Memorial Hospital. All consent forms and questionnaires were read aloud to ensure that reading problems would not interfere with understanding the written material. On the day of the laboratory assessment, children and caregivers were transported to the laboratory by project staff. Caregivers were paid $30 and children received toys worth about $7 at each laboratory visit. In addition, caregivers were paid $15 at each home visit.

Measures

Outreach personnel collected information from caregivers, trained child examiners conducted the child assessments, and trained interviewers conducted a clinical interview with the caregiver. Additionally, trained and reliable observers coded child language and parent–child interaction from videotape. Child examiners, interviewers, and coders were blind to group assignment. Guided by the literature cited earlier, we selected the measures detailed in the following paragraphs for investigation.

Maternal social-economic and obstetric risk measures. Measures of birth mothers included information about sociodemographic status and obstetric risk, such as number of previous live births, an obstetric optimality score (OCS; Littman & Parmelee, 1978), and receipt (or nonreceipt) of prenatal care for the birth mother during the first half of pregnancy. The OCS consists of 41 maternal and infant items with criteria for scoring each item as optimal or nonoptimal, such as previous premature births (with 2 or fewer scored as optimal), bleeding during pregnancy, multiple births, placental infarction, 1- and 5-min Apgar scores, and birthweight greater than 2500 g. The summary optimality score consisted of the percentage of items scored as optimal. Finally, the infant gestational age was determined with the Ballard score (Ballard, Novak, & Driver, 1979), and preterm status was defined as having a Ballard score of 36 weeks or less. Because the average gestational age for full-term births in the sample was 39.44 (SD = 1.31), the ages of the preterm infants were corrected using 39 weeks as the standard, and at

follow-up, preterm infants were seen at their corrected age.

Parenting risk. At each follow-up period, an interviewer administered the Structured Clinical Interview (SCI; Platzman et al., 2001) to the adult accompanying the child. We selected the following items from the SCI for the current report: the identity and age of the respondent, the respondent's designation of the child's most frequent caregiver, frequency of the child's contact with birth mother and birth father, composition of the household in which the child lived, and involvement of child protective services with the child.

The adult accompanying the child was regarded as the primary caregiver for the following reasons. In 138 cases (93%), the accompanying adult designated herself or himself as the most frequent caregiver. In the 11 remaining cases (8 in the cocaine group and 3 in the nonuser group), the birth parent accompanied the child but designated another family member ($n = 8$, mostly the grandmother) or nonfamily member ($n = 3$) as the most frequent caregiver. Given that in all 11 cases the birth parent lived with the child and was both the respondent and the designated major caregiver on all previous follow-up visits, we elected to designate the birth parent, rather than the person designated by the birth parent, as the primary caregiver. Using this definition, 34 and 2 two-year olds were categorized in nonparental care in the cocaine and the nonuser groups, respectively. In only 1 case the birth mother lived in the household of the child who was classified in nonparental care. In that case, the child's aunt was both the respondent and the designated most frequent caregiver.

Measures of caregiving at 24 months. These measures included the identity (parent, relative, unrelated) and age of the current caregiver; the child's age at the start of the current custody; the number of custody changes and the identity of the previous caregivers (collected with the SCI; Platzman et al., 2001); background information for the current caregiver (education, monthly income, and marital status); self-reported drug use during the previous 30 days, as summarized with the drug cluster score from the Addiction Severity Index (ASI; McGahan, Griffith, Parente, & McLellan, 1986); the Global Severity Index (GSI) from the Symptom Checklist (SCL–90–R; Derogatis, 1986); the total score of the Home Observation for the Measurement of the Environment (HOME; Caldwell & Bradley, 1984); and the total score of the Parenting Stress Index (short form; Abidin, 1995). The last two measures were obtained at 18 months. Scores on the GSI were highly skewed; they ranged from 0 to 3 with a median of 0.13 and a mean of 0.27. Consequently, they were recoded for subsequent analyses: 0 remained 0 whereas scores up through 0.05, 0.10, 0.15, 0.25, 0.50, and 3.00 were recoded 1 through 6, respectively.

Outcome measures. We collected 2-year child outcome measures in three developmental domains: (a) physical growth (length, weight, head circumference), (b) cognitive and language development, and (c) social and emotional status. In the cognitive domain, we used the Bayley Scales of Infant Development (BSID; Bayley, 1969) to determine the child's MDI and PDI. (The first edition of the BSID was used in this study because the second edition had not been released generally when the first wave of the longitudinal study was done, although it was available when the children were 2 years old. The authors did not want to compare development across two versions of the test.) Communication and language measures were obtained from a sample of the communicative behavior exhibited by the child during four communicative temptations and a book-sharing task (from the Communication and Symbolic Behavior Scales; Wetherby & Prizant, 1990). A communicative temptation is a structured situation that is designed to entice child-initiated verbal and nonverbal communicative acts (gestures, vocalizations, or verbalizations directed toward the examiner that serve a communicative function). For instance, a penguin is wound up and presented to the child; when the penguin is deactivated, the examiner waits for the child to initiate a request by word or gesture for rewinding the toy. If the child does not readily initiate a communicative act, the presenter encourages the child with the prompt "Need help?" and, if needed, by extending an open hand on the table, at least 12 in. from the penguin. In our sample, these tasks lasted an average of 10.3 min ($SD = 3.5$). Two summary measures were used for this report: the rate of communicative acts per minute and the number of different gestures used. These measures were coded from videotape by coders trained to a minimum of .70 reliability using Cohen's kappa (Bakeman & Gottman, 1997).

In the social-emotional domain we used three outcome measures. First, we used the Adaptive Behavior Index from the Early Coping Inventory (Zeitlin, Williamson, & Szczepanski, 1988), which is an observational instrument designed to assess the sensorimotor, organizational, and reactive behaviors used by infants and toddlers in everyday situations. The effectiveness of the child's behavior on each of 48 items is rated on a 5-point scale (1 = *not effective* to 5 = *consistently effective across situations*). The child examiner used his or her experience with the child

during the entire day to score the inventory. The Adaptive Behavior Index represents the mean effectiveness on all items. Our second measure consisted of the Total Problems *T* score from the Child Behavior Checklist for Ages 2–3 (CBCL; Achenbach, 1986). Finally, we derived a measure of positive dyadic interaction from the Mother–Infant/Toddler Feeding Scale (Chatoor, 1986) by combining three of its subscales: Dyadic Reciprocity (16 items, rated 0–3, such as "mother shows pleasure towards infant in gaze, voice or smile" or "infant looks at mother"; $\alpha = .79$), Maternal Noncontingency (7 items, rated 0–3, such as "mother misses infant's cues" or "infant cries when bottle or food is taken away"; $\alpha = .63$), and Dyadic Conflict (12 items, rated 0–3, such as "mother makes negative or critical remarks to infant" or "infant pushes food away or throws food"; $\alpha = .78$). The final score was the average *z* score for these scales (the last two were reverse-scored so that larger numbers indicate more positive interaction), multiplied by 10 for interpretability. Coders trained until they reached reliability levels of .70 or better using Cohen's kappa (Bakeman & Gottman, 1997) scored each scale item after watching a 10-min videotaped parent–child interaction during a feeding.

Data Analysis

Differences between cocaine nonparental care, cocaine parental care, and nonuser groups were analyzed with ordinary least squares (OLS) multiple regression for continuous variables and logistic regression for binary variables. Consistent with our hypotheses, predictor variables included two contrast terms (Cohen & Cohen, 1983): The first compared the 83 cocaine with the 63 nonuser dyads, and the second compared the 34 cocaine nonparental care with the 49 cocaine parental care dyads. Effect-size statistics reported are regression coefficients for continuous variables and the exponentiation of the regression coefficient for binary variables (i.e., e^B or the partial odds ratio). Regression coefficients greater than 0 and partial odds ratios greater than 1 indicate higher scores for the cocaine-exposed versus the nonuser group, and higher scores for the cocaine nonparental care versus the cocaine parental care group. Analyses of toddler outcome variables included sex and gestational age as covariates. (In recognition of the polydrug nature of user groups, investigators generally include indicators of others drugs as covariates when comparing cocaine and nonuser groups. In our case, that would not be good multiple regression practice. Tobacco use was low, and alcohol and marijuana use were not reported by those in our nonuser group; thus, not only would potential covariates associated with these drugs be highly skewed, they would covary unacceptably with the cocaine versus nonuser contrast. Moreover, such covariates become important when cocaine versus nonuser groups vary, to check that effects are due to cocaine and not to others drugs; when groups do not vary, analysis of potential covariates is not needed to conclude that cocaine did not have an effect.)

Results

Differences Between Birth Mothers Who Did and Did Not Use Cocaine

Our first hypothesis predicted increased risk for cocaine-using compared with nonusing birth mothers (see the cocaine vs. NU column, Table 2). With respect to maternal background, users were older than nonusers, less likely to have graduated from high school, and more likely to have low incomes—although this last difference was primarily due to the 94% of birth mothers in the cocaine nonparental care group who reported low incomes. With respect to obstetric risk, cocaine users reported more previous live births than nonusers, had lower obstetric optimality scores, and were less likely to have had prenatal care during the first half of pregnancy. With respect to parenting risk, 41% of the using mothers compared with 3% of the nonusing mothers relinquished care of their children; 32% and 53% of the cocaine-exposed children, compared with 0% and 13% nonexposed children, had no contact with their birth mother and father, respectively, at 24 months of age, and 49% of the cocaine-exposed children but only 6% of the nonexposed children were involved with child protective services by 24 months. Thus, we found the expected pattern of greater socioeconomic, obstetric, and parenting risk among cocaine-using compared with nonusing mothers.

There are 78 possible correlations between the 13 variables in Table 2. The 6 correlations involving the four parenting risk variables ranged from .40 to .75, and obstetric optimality correlated .62 with gestational age, but only 1 of the remaining 72 possible correlations between pairs of Table 2 variables was greater than .30 absolute, the lower threshold for what Cohen (1988) characterized as moderate (.36 for low income and relinquish care). Based on these correlations, possibly similar results might be expected when analyzing parental risk variables and when analyzing obstetric optimality and gestational age.

Differences Between Cocaine-Exposed and Nonexposed 2-Year-Olds

Our second hypothesis predicted no differences between cocaine and nonuser groups for toddler growth and cognitive and language variables, and none was found (see the cocaine vs. NU column, Table 3). Although we had predicted differences between cocaine and nonuser groups for social-emotional variables, the groups did not differ on two of the three social-emotional variables (the Adaptive Behavior Index or the CBCL Total Problems score). The two groups did differ, however, on the positive dyadic interaction index: The mean score was -1.9 for the cocaine-exposed versus 2.5 for the nonexposed 2-year olds. Two additional variables were included in these multiple regressions: gestational age, which we address shortly when discussing differences between cocaine-exposed 2-year-olds cared for by parents or others, and child's sex, in case it affected any of these outcome variables.

Only one significant sex effect was noted: Females scored higher than males on the Bayley MDI. However, the sex main effect was qualified with a Sex × Group interaction, $F(2, 136) = 6.0$, $p < .01$. MDI means for males were 90.8, 74.4, and 80.8 for the cocaine nonparental care, cocaine parental care, and nonuser groups, respectively; the corresponding means for females were 84.0, 84.0, and 89.2. The mean MDI score for males in nonparental care was significantly higher than the mean for those in parental care, but neither of these differed significantly from the mean for male toddlers of nonusers per a Tukey post hoc test ($p < .05$). In contrast, means for females did not differ significantly among these three groups.

There are 45 possible correlations among the 10 variables in Table 3. The 3 toddler growth variables were intercorrleated (range = .22 to .48), but only 1 of the remaining 42 possible correlations among pairs of Table 3 variables was greater than .30 absolute (.33 for communicative acts and gestures). Based on these correlations, possibly similar results might be expected when analyzing toddler growth variables.

Differences Between Cocaine-Using Birth Mothers Who Kept or Relinquished Care of Their Children

Our third hypothesis predicted more prenatal cocaine use and higher socioeconomic and obstetric risk for cocaine-using mothers who relinquished care of their infants compared with mothers who continued to care for their children. Mothers who relinquished care reported a higher frequency of cocaine use prenatally than mothers who continued caring for their children ($M = 3.85$ vs. 3.14, where

Table 3
Group Means for Growth, Cognitive-Language, and Social-Emotional Outcome Variables at 24 Months

		Group							
		Cocaine non-parental care (NP) ($n = 34$)		Cocaine parental care (PC) ($n = 49$)		Nonuser (NU) ($n = 63$)		Contrast	
Variable	*N*	*M*	*SD*	*M*	*SD*	*M*	*SD*	Cocaine vs. NU	NP vs. PC
Growth									
Length (cm)	137	85.4	(4.0)	86.4	(4.1)	85.4	(5.5)	.05	−.05
Weight (kg)	140	12.5	(1.7)	13.1	(2.0)	12.5	(1.6)	.09	−.09
Head circumference (cm)	144	48.4	(2.3)	48.9	(2.0)	48.4	(1.9)	.07	−.04
Cognitive-language									
MDI	143	87.3	(14.3)	79.5	(9.9)	84.6	(12.4)	−.05	.26**
PDI	142	102.8	(14.7)	102.2	(15.1)	100.0	(16.0)	.08	.04
Communicative acts	128	2.2	(1.0)	1.8	(0.9)	2.0	(0.8)	−.05	.19*
Gestures	128	2.9	(1.6)	2.7	(1.5)	2.5	(1.4)	.09	.03
Social-emotional									
Adaptive Behavior Index	145	4.3	(0.4)	4.1	(0.5)	4.3	(0.5)	−.06	.18*
CBCL Total Problems	142	48.3	(10.8)	55.4	(13.1)	48.8	(11.5)	.12	−.22**
Dyadic interaction	137	1.4	(7.6)	−4.0	(8.6)	2.5	(5.8)	−.25**	.30**

Note. MDI = Bayley Mental Development Index; PDI = Bayley Psychomotor Development Index; CBCL = Child Behavior Checklist. Contrasts are ordinary least squares regression coefficients. Regression coefficients >0 indicate cocaine (NP and PC combined) >NU, and cocaine NP >cocaine PC. Sex and gestational age were covariates.
*$p < .05$. **$p < .01$.

3 = 1 to 2 times per week and 4 = 3 to 4 times per week), $t(73) = 2.00$, $p < .05$. However, the two groups did not differ with respect to prenatal marijuana, alcohol, and tobacco use (see Table 1). With respect to maternal background (see the NP vs. PC column, Table 2), mothers who relinquished care were more likely to report incomes less than $300 per month than mothers who did not relinquish their children, but the two groups did not differ significantly with respect to age, education, or proportion never married.

Again consistent with our hypothesis, obstetric optimality and gestational age were lower for mothers who relinquished as opposed to kept their children (consequently proportion preterm was higher, 53% vs. 24%), although no differences were noted for number of previous live births or the proportion receiving prenatal care during the first half of pregnancy. Finally, effects for parenting variables follow essentially by definition: Few toddlers in nonparental care had contact with their birth mothers or fathers and most (82%) had contact with child protective services, whereas most toddlers in parental care had contact with their birth mothers and fathers and few (27%) had contact with protective services.

Differences Between Cocaine-Exposed 2-Year-Olds Cared for by Parents or Others

Our fourth hypothesis predicted more positive social-emotional development at 24 months for cocaine-exposed toddlers in nonparental care compared with those in parental care. As expected, toddlers in nonparental care scored higher on the Adaptive Behavior Index, lower on the CBCL Total Problems score, and higher on the positive dyadic interaction index; they also scored higher on the MDI and on the rate of communicative acts but did not differ on the PDI and the number of gestures (see the NP vs. PC column, Table 3). Recall that the gestational age for toddlers in nonparental care was lower than for those in parental care (Table 2). To assure that this did not affect the group differences just reported, gestational age was entered as a covariate when analyzing the 24-month outcomes listed in Table 3. The covariate was significant only for toddler weight and head circumference.

Our fourth hypothesis also predicted a more positive caregiving environment at 24 months for cocaine-exposed toddlers in nonparental care compared with those in parental care. As expected, nonparental caregivers scored lower on the GSI, higher on the HOME, and lower on parental stress (see Table 4).

Characteristics of Parental and Nonparental Caregivers of Cocaine-Exposed Toddlers

Characteristics of the current caregivers when the toddlers were 24 months of age are given in Table 4. For the cocaine parental care (and nonuser) groups, these characteristics are for essentially the same caregivers as described in Table 2 (maternal background), albeit now about 2 years later, but the characteristics of the cocaine nonparental group describe caregivers who took over care of cocaine-exposed children. More than half of the nonparental caregivers were relatives (29% grandmothers, 24% other relatives). Additionally, nonparental caregivers were older, reported a higher monthly income, and were more likely to have been married than the birth parents who continued to care for their cocaine-exposed children.

Although we had not hypothesized differences for nonkin and kin caregivers within the nonparental care group, we nonetheless conducted these analyses as a descriptive and exploratory matter (a nonkin vs. kin contrast was added to the multiple regressions). Nonkin caregivers were younger (38.6 vs. 47.6) and had more years of education (12.6 vs. 11.3) than kin caregivers, which probably reflects the presence of many grandmothers among kin caregivers, but otherwise no significant differences were noted for the Table 4 caregiver and caregiving environment variables. However, three of seven differences were significant for the Table 3 cognitive-language and social-emotional outcomes, all favoring nonkin caregivers: Toddlers with nonkin as opposed to kin caregivers scored higher on the MDI (92 vs. 83), made more gestures (3.4 vs. 2.3), and scored higher on the dyadic interaction index (3.9 vs. −1.4). (As noted earlier, 1 toddler was classified in nonparental care—because the toddler's aunt was both the respondent and the designated most frequent caregiver—although the birth mother lived in the household. When this case was removed, the results were essentially the same, and in no case was statistical significance changed.)

We also explored stability of care over time. Most of the nonparental caregivers (31 of 34, or 91%) had assumed care of the infants before 12 months of age: 14 from birth, and 12, 5, and 3 from 0 to 6, 6 to 12, and 12 to 24 months of age, respectively. Children experienced little discontinuity in their care: Fourteen experienced no custody changes (i.e., were relinquished at birth), whereas 18 experienced one and 2

Table 4
Group Means and Percentages for Caregiver Identity and of Caregiving Variables at 24 Months

		Group						Contrast	
		Cocaine non-parental care (NP) ($n = 34$)		Cocaine parental care (PC) ($n = 49$)		Nonuser (NU) ($n = 63$)			
Variable	*N*	*M* or %	*SD*	*M* or %	*SD*	*M* or %	*SD*	Cocaine vs. NU	NP vs. PC
Identity of caregiver									
Parent	146	0		100		97		—	—
Relative	146	53		0		3		—	—
Unrelated	146	47		0		0		—	—
Caregiver characteristics									
Age (years)	145	43.5	(13.7)	32.2	(5.3)	29.0	(8.3)	.41**	.39**
Education (years)	140	11.9	(1.9)	11.3	(1.6)	11.6	(1.7)	−.00	.13
Monthly income ($)	141	1,181	(903)	722	(441)	985	(708)	−.02	.24**
Never married	140	24		78		61		.87	0.30**
Caregiving environment									
Global Severity Index	141	1.8	(2.7)	4.2	(5.9)	2.2	(3.4)	.09	−.21*
HOME (18 months)	135	36.8	(4.5)	32.0	(6.9)	35.3	(4.7)	−.07	.30**
Parenting Stress Index (18 months)	136	66.6	(21.0)	87.2	(20.8)	70.3	(18.9)	.15	−.36**

Note. HOME = Home Observation for Measurement of the Environment. Means and standard deviations are given for continuous variables, and percentages are given for binary variables. Contrasts are ordinary least squares regression coefficients for continuous variables, partial odds ratios (e^B) from logistic regression for binary variables. Regression coefficients >0 and partial odds ratios >1 indicate cocaine (NP and PC combined) > NU, and cocaine NP > cocaine PC.
*$p < .05$. **$p < .01$.

experienced two custody changes. To determine whether custody change affected cognitive-language or social-emotional 24-month outcome, we added a no-change versus one or more changes contrast to the multiple regression, but no effects were significant.

Predicting Cognitive and Social-Emotional Outcome at 24 Months

The analyses suggest one final analysis. When predicting 24-month outcome, we expected and found effects for the nonparental versus parental care contrast, yet, not surprising, caregiver characteristics and the caregiving environment provided by these two groups of caregivers differed. To gauge whether differences in outcome were associated more with the caregiver characteristics or caregiving environment than with caregiving group status, we regressed cognitive-language and social-emotional outcome variables, first on gestational age and sex as covariates, then on caregiver characteristics, next on caregiving environment variables, and finally on the three contrasts representing group membership (including the nonkin vs. kin nonparental care contrast). Results of these hierarchic regressions are shown in Table 5 for the three regressions for which any of these blocks accounted for significant proportions of variance. By themselves, the covariates did not account for significant outcome variance, nor did caregiver characteristics. For the MDI, the caregiving environment (primarily the HOME) accounted for an additional 8% and group contrasts, yet an additional 6% (primarily the nonkin vs. kin contrast; $p = .09$ for the nonparental vs. parental care contrast). For the CBCL, caregiving environment variables (primarily the GSI and Parenting Stress Index) accounted for an additional 34%, but group contrasts did not add significantly. For positive dyadic interaction, the caregiving environment (primarily the HOME) accounted for an additional 13% and group contrasts, yet an additional 12% (the nonparental vs. parental care and nonkin vs. kin care contrasts; when other variables were included, the significant cocaine vs. nonuser contrast from Table 3 was no longer statistically significant). Thus, for dyadic interaction and after taking other variables into account, cocaine-exposed toddlers in nonparental care scored higher than those in parental care, and cocaine-exposed toddlers in nonkin, nonparental care scored higher than those in kin, nonparental care. A similar advantage of nonkin versus kin care was also found for the MDI.

Another factor frequently associated with child outcome is caregiver current drug use. When we

Table 5
Multiple Regression Statistics for Cognitive and Social-Emotional Outcome at 24 Months

		Outcome variable					
		MDI		CBCL		Dyadic interaction	
Step	Predictor variable	β	ΔR^2	β	ΔR^2	β	ΔR^2
1	Gestational age	.12		−.09		.16	
	Infant's sex	.19*	.04	.03	.00	.05	.01
2	Caregiver age	.07		−.03		−.09	
	Caregiver education	.02		−.01		−.10	
	Caregiver income	.07	.05	.06	.00	.03	.02
3	Global Severity Index	.14		.42**		.01	
	HOME (18 months)	.22*		.04		.28**	
	Parenting Stress Index (18 months)	−.04	.08**	.29**	.34**	.01	.13**
4	Cocaine vs. nonuser	−.02		.04		−.13	
	Nonparental vs. parental care	.18		−.06		.29**	
	Nonkin vs. kin care	.21*	.06*	.01	.01	.19*	.12**

Note. MDI = Bayley Mental Development Index; CBCL = Child Behavior Checklist; HOME = Home Observation for the Measurement of the Environment. ΔR^2 is the additional variance accounted for at each step. Regression coefficients are for the last step; coefficients >0 indicate cocaine (NP and PC combined) > NU, cocaine NP > cocaine PC, and cocaine NP nonkin > cocaine NP kin care. Sex was coded 0 = male, 1 = female.
*$p<.05$. **$p<.01$.

asked caregivers whether they had used drugs in the past 30 days, none in the nonuser group obtained a score >0 on the ASI current drug use cluster, 1 did in the nonparental group, and 9 did in the cocaine parental care group. When we analyzed cognitive and social-emotional outcomes for toddlers in the cocaine parental care group, only PDI scores were affected by reported recent drug use ($\Delta R^2 = .16$, $p<.05$, when current drug use was added to the Steps 1 through 3 variables listed in Table 5). The mean PDI score for those 9 toddlers whose parents reported current drug use was 91.2 but 104.8 for the 38 whose parents did not.

Discussion

This study examined the effect of the postnatal caregiving environment on the development of 2-year-olds whose mothers used cocaine during pregnancy. In particular, we compared toddlers whose care was assumed by others with those who continued to be cared for by birth parents. Our results suggest that, in spite of their higher perinatal risk, cocaine-exposed toddlers in nonparental care had more optimal development than those in parental care, although nonkin versus kin nonparental care also emerged as a potentially important consideration.

Cocaine use during pregnancy is associated with increased socioeconomic and obstetric risk, even within low-income, disadvantaged samples such as the one we studied. Because this phenomenon has been widely reported in the literature, we both expected and found differences between cocaine-exposed and unexposed infants at birth. One of the consequences of cocaine use during pregnancy can be the birth parents' inability to care for their children. Indeed, in our sample, 41% of the parents of cocaine-exposed children relinquished their care to others. Defining who these others are is not always easy. As Mayes and Bornstein (1995) wrote, "Defining who is the primary caregiver is a difficult problem in studies of substance-abusing parents because in many substance-abusing families, a child may be in the care of many different adults in the course of a day or week" (p. 261). We defined the caregiver as the person (parent or nonparent) who accompanied the child to the 24-month follow-up visit, although there are other possibilities (e.g., Bandstra et al., 2002; Hurt et al., 1996). In spite of some variability in definition, however, the nonparental care rates of cocaine-exposed and nonexposed toddlers in our sample are comparable to those reported by others (e.g., Frank et al., 2002; Singer et al., 2002).

In general, the nonparental caregivers of cocaine-exposed toddlers had more economic resources, experienced less psychological distress and parenting stress, and provided a more stimulating and responsive home environment than birth parents who continued to care for their cocaine-exposed children. Differences between parental and nonparental caregivers underscore the importance of evaluating the

potential developmental impact of prenatal cocaine exposure within the context of type of care.

When we simply compared exposed and nonexposed toddlers at 2 years of age without consideration for type of care, we did not find group differences in growth, cognitive, or most social-emotional variables. A lack of differences was expected and is consistent with our previous findings in a reduced sample (Platzman et al., 2001) and with a recent review by Frank et al. (2001). More recently, a few cocaine-related effects have been reported in cognitive (Bennett, Bendersky, & Lewis, 2002; Singer et al., 2002) and language development (Bandstra et al., 2002; Morrow et al., 2003; both using the same cohort of children). It is not yet clear to what extent these data challenge Frank et al.'s conclusions, although our findings fit the pattern reported by Frank et al.

We had hypothesized that cocaine-related effects might become evident especially in the social-emotional domain. Indeed, with only gestational age and sex as covariates, we did find a group difference in one of our social-emotional measures (dyadic interaction): Exposed toddlers and their caregivers were less emotionally expressive and responsive to each other during a feeding episode. Although this finding is similar to those observed by others during separation and reunion episodes (Beeghly et al., 2003; Burns, Chethik, Burns, & Clark, 1997; Molitor, Mayes, & Ward, 2003; Ukeje, Bendersky, & Lewis, 2001), this effect no longer achieved a conventional level of statistical significance when caregiver characteristics and the caregiving environment were taken into account. Thus, we return to a point we made earlier: To evaluate child outcome, type of care needs to be taken into consideration.

As noted earlier, although cocaine-exposed children in nonparental care were at higher perinatal risk, they experienced a more optimal caregiving environment and performed better in several developmental domains by the time they were 2 years of age than those in parental care. Like Bennett et al. (2002), we found that with respect to cognitive development, the protective effect of the environment (in our case nonparental care) was the case for boys but not girls.

An additional variable that was not part of our hypotheses, but that was suggested to us by Frank et al. (2002), proved important. Within the group of nonparental caregivers, nonkin caregivers were younger and more educated than kin caregivers and their toddlers scored higher on the Bayley MDI and on the dyadic interaction index. Thus, like Frank et al., we found that the protective effect of nonparental care on cognitive development was in part due to that of nonkin care, and our data suggest that this protective effect extends to aspects of social-emotional development as well.

In an effort to understand better why nonparental versus parental, and nonkin versus kin nonparental care, should affect toddler outcome, we regressed indexes of cognitive-language and social-emotional development on caregiver characteristics and caregiving environment measures before taking group contrasts into account. Prediction of three outcomes proved interesting. Caregiving characteristics such as education and income did not contribute significantly to prediction, but more proximal aspects of the caregiving environment did, specifically the HOME for the MDI and positive dyadic interaction and caregiver psychological well-being and parenting stress for the CBCL. However, the group contrasts still accounted for significant additional variance for the MDI and the positive dyadic interaction, suggesting that as of yet unidentified variables associated with nonparental nonkin, nonparental kin, and parental caregivers are affecting differences in these two key outcomes. One such variable is current drug use, which predicted lower PDI scores in the cocaine parent group and has been found to affect child outcome negatively by others (e.g., Accornero, Morrow, Bandstra, Johnson, & Anthony, 2002). Additional characteristics of these different types of care that are associated with variation in toddler outcome is a matter that requires further study. Still, the significant relationship between maternal psychological health and the CBCL identified in a sample of cocaine-using birth mothers and their preschool children (Accornero et al., 2002) is consistent with our findings. Moreover, caregiver psychological health has been found to be associated with parenting (Hans, Bernstein, & Henson, 1999; Kettinger et al., 2000), with child social-emotional functioning (Rodning et al., 1991; Swanson et al., 2000), and with cognitive development (Singer et al., 1997) in drug users and their children.

This study has several limitations. Some are inherent in a longitudinal, correlational study of a high-risk cohort of this kind, but others result from the demographic, neonatal, and possibly geographic characteristics of the cohort. We examined a low-income, African American cohort from a major urban area in the southeastern United States. However, the sample was not stratified for caregiver type at intake; thus, the results with respect to the impact of caregiver type need to be interpreted with caution. Additionally, because the study had been designed initially to examine whether full-term and preterm

infants would be differentially affected by prenatal cocaine exposure (Brown et al., 1998), we had enrolled relatively high percentages of preterms in the cocaine and nonuser groups. The special characteristics of our sample provide our study with potential limitations on the extent to which results can be generalized to other populations, but also with unique opportunities. For instance, in our cohort cocaine-exposed toddlers in nonparental care had been at higher neonatal risk compared with those in parental care. In contrast, Frank et al. (2002) had excluded preterm infants from their sample and, perhaps as a result, did not find differences in the neonatal characteristics between the two groups of infants. Finally, there are no doubt regional differences in the level of funding and the practice of child protective services and in the traditions of the involvement of the extended family in childrearing, which would affect whether cocaine-exposed children are placed with kin or nonkin caregivers.

In summary, we believe these results add important detail as we attempt to understand better how maternal substance use in pregnancy affects toddler development. If we accept a teratogenic explanation for any observed negative outcomes in cocaine-exposed children, there is little motivation to provide postnatal interventions in the form of intervention services to children or parenting services to caregivers. These results suggest that, in fact, many of the negative outcomes observed in children of drug users can be attributed to caregiving factors and that these can be ameliorated, thereby allowing children to achieve more optimal developmental outcomes. Such support could be provided either through direct intervention with children, by supporting women in their recovery from substance abuse, and in helping them improve their parenting skills (e.g., see Black et al., 1994). Finally, in agreement with Frank et al. (2002), our results suggest that kin caregivers of cocaine-exposed infants and toddlers may also need special attention and support, including in the area of parenting.

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