



Cocaine exposure and mother–toddler social play

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Received 1 January 2004; received in revised form 18 October 2004; accepted 2 November 2004

Abstract

This study compared the play interactions of 18-month-old cocaine-exposed toddlers and their mothers ($n = 48$) to non-cocaine-exposed comparison toddlers and their mothers ($n = 77$). Coders blind to drug-exposure status reliably coded the interactions for maternal directiveness, positivity, and sensitivity; child social initiative and positivity; and dyadic responsiveness. There were no cocaine exposure group differences on any of the measures, with or without statistical controls for birth weight, SES, maternal age, and prenatal exposure to alcohol, marijuana, and cigarettes. Irrespective of cocaine exposure, low birth weight was associated with fewer maternal positive vocalizations and lower levels of maternal sensitivity. In higher SES dyads, children were more likely to respond to mother requests. The absence of cocaine exposure differences in social interactive behaviors during mother–child play in a relatively large sample of mothers and their children, is discussed with respect to the existing literature.

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Keywords: Mother–child interaction; Play; Cocaine; Prenatal drug exposure

Since the first studies were published in the mid 1980's, research into the effects of prenatal cocaine exposure has revealed a mixed pattern of effects. The behavioral effects of cocaine appear to be subtle rather than global, and may not be evident in measures of children's general level of functioning (Frank, Augustyn, Grant Knight, Pell, & Zuckerman, 2001; Lester & Tronick, 1994; Lester, LaGasse, & Seifer, 1998; Lester et al., 2002). Studies examining social-emotional regulatory abilities have been somewhat

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more revealing of drug exposure effects, but have not focused sufficiently on the interactive environment (Beeghly & Tronick, 1994).

There is evidence of cocaine exposure deficits in emotional functioning and regulation. Studies have found exposed infants to show deficits in alertness and arousal, as well as emotional expression (Alessandri, Sullivan, Imaizumi, & Lewis, 1993; Das Eiden, Lewis, Croff, & Young, 2002; Mayes, Bornstein, Chawarska, Haynes, & Granger, 1996; Mayes, Feldman, & Granger, 1997; Roumell, Abramson, Delaney, & Willey, 1997), but there has been relatively little research on this issue after 1 year of age. There also has not been adequate research examining how possible exposure deficits might be expressed in social interaction. Given the dynamic nature of social interaction, an assessment of both interactive partners is warranted. The current study approaches mother–child play as a milieu for dyadic social interaction, focusing on interactive behaviors that have shown prominence in the literature and an ability to reveal meaningful variation in the interaction between at-risk dyads.

Mother's participation in play has been shown to positively influence the child's level of play (Fiese, 1990; O'Connell & Bretherton, 1984; Slade, 1987). However, mother participation needs to become less directive after the first year, as children are able to take on a leading role and try out new skills (Tamis-LeMonda & Bornstein, 1991). The persistence and prominence of directiveness may indicate a less optimal interactive pattern in the dyad.

There is some evidence that drug-using mothers show less emotional expression, and are less responsive and engaged with their infants (Burns, Chethik, Burns, & Clark, 1991; Gottwald & Thurman, 1994; LaGasse et al., 2003). In turn, this inattention can result in fewer dyadic reciprocal, cooperative interactions (Mayes et al., 1997). Yet other research groups have not found associations between cocaine exposure and maternal interaction in early infancy (Neuspiel, Hamel, Hochberg, Greene, & Campbell, 1991) or at 1 year (Ukeje, Bendersky, & Lewis, 2001). However, in one of the few studies beyond infancy, a large sample of cocaine exposed preschoolers and their mothers revealed a poorer quality of interaction than the non-exposed group (Johnson et al., 2002). There was more maternal intrusiveness, hostility, poor quality of instruction, and lower maternal confidence in cocaine exposed dyads. Moreover, recent results from the Maternal Lifestyle Study (Seifer et al., 2004) show a small association between combined cocaine and opiate exposure and attachment classification at 18 months, with drug exposed children more likely to show an ambivalent classification. Thus, there is support for drug exposure effects on dyadic interaction.

Maternal sensitivity and responsiveness have long been implicated as important variables in the mother–child relationship (Ainsworth, Bell, & Stayton, 1974; Bornstein, 1989; Bernstein, Jeremy, & Marcus, 1986; DeWolff & van IJzendoorn, 1997). Maternal responsiveness has been associated with increased child competence in cognition and language, as well as decreased behavior problems (McGrath, Sullivan, & Seifer, 1998; Moore, Saylor, & Boyce, 1998; Wakschlag & Hans, 1999). This has been demonstrated in both normative (e.g. Olson, Bates, & Bayles, 1984; Tamis-LeMonda, Bornstein, & Baumwell, 2001) and at-risk populations (Kelly, Morisset, Barnard, Hammond, & Booth, 1996; McGrath et al., 1998), but has not been adequately explored in cocaine-exposed samples.

Research on drug-exposed children's social behavior has shown preschoolers to demonstrate less social initiative, and fewer positive social interactions at 8–10 months (Beckwith et al., 1994; Burns et al., 1991). Less dyadic enthusiasm overall in the interaction has also been reported (Burns, Chethik, Burns, & Clark, 1997). These social behaviors may be particularly lacking in drug-exposed dyads.

Factors associated with cocaine exposure that can put the child at increased risk include low infant birth weight and low maternal socioeconomic status (Addis, Moretti, Syed, Einarson, & Koren, 2001; Lutiger, Graham, Einarson, & Koren, 1991). Low birth weight in itself is known to be a risk factor for

poor child outcome, particularly when combined with other risk factors (e.g. Hack, Klein, & Taylor, 1995; Hollomon, Dobbins, & Scott, 1998). The majority of research on prenatal drug use has focused on women of low SES, who typically present with a range of adverse sociodemographic and lifestyle factors (Woods, Behnke, Eyler, Conlon, & Wobie, 1995). Low maternal education level, an index of lower SES, has been associated with the increased risk of a variety of poor child outcome (e.g. McLoyd, 1998), including poor quality mother–child interaction (Spiker, Ferguson, & Brooks-Gunn, 1993). As such, both SES and low birth weight are important variables in the assessment of cocaine-exposed dyads.

In summary, there are important features of a mother's interaction style that can impact the child. A pattern of interacting associated with poor child outcome in other populations of at-risk children has also emerged from research with cocaine-exposed samples. Previous research has supported the importance of mother directiveness, sensitivity, and positive affect in the interaction, as well as child social initiative and positivity, and dyadic responsiveness. We anticipated cocaine-exposed dyads would display a less optimal interaction as assessed by measures of these constructs. We also expected low socioeconomic status and low infant birth weight, risk factors often associated with cocaine exposure, to have a detrimental impact on the play interaction.

1. Method

1.1. Participants

The 125 participants in this study are part of the Miami sample ($N=234$) of the four-site Maternal Lifestyle Study (MLS). The MLS is a longitudinal multi-site study investigating the effects of prenatal cocaine/opiate exposure on child outcome, conducted under the auspices of the NICHD Neonatal Research Network (Bauer et al., 2002; Lester et al., 2002). Subjects were matched on race, sex, and gestational age (see Lester et al., 2002; Messinger et al., 2004, for details). Of the 212 participants who came in for the 18-month visit, 156 completed the play assessment. The play assessment was excluded when the larger research protocol precluded completion of the play assessment, which was ancillary project. Completed assessments were excluded if the play partner was a non-biological mother, a biological mother who had only recently regained child custody, a user of opiates, or if the assessment had technical problems preventing coding ($n=31$). The final sample of 125 participants were designated as cocaine exposed ($n=48$) by either maternal self-report at delivery or a meconium toxicology screen positive for cocaine metabolites; non-exposure ($n=77$) was determined by negative self-report of use and a negative meconium toxicology screen (Lester et al., 2001).

There were no significant group differences in education level, marital status, SES or race (Table 1). The majority of mothers in both groups were African-American, never married, with less than a high school education. Mean maternal age differed between the groups, with nearly 70% of the exposed group between 26 and 35 years, and over half of the comparison group between 18 and 25 years.

Socioeconomic status was indexed by the standard algorithm described by Hollingshead (1975), as modified for low-income caregivers (LaGasse et al., 1999). The child's primary caregiver provided this data at the 1-month clinic visit. There were no significant differences between the groups on this SES index. Data on the prenatal use of other drugs was collected postpartum at the time of initial subject recruitment. Use of alcohol, tobacco, and marijuana was present in both groups (see Table 2). There was significantly more prenatal use of alcohol, tobacco and marijuana in the cocaine-exposed group.

Table 1
Maternal demographics

Maternal demographics	Exposed (%) (<i>n</i> = 48)	Comparison (%) (<i>n</i> = 77)	<i>p</i>
Maternal age			
18–25	8 (16.7%)	42 (54.5%)	0.000**
26–35	33 (68.8%)	30 (39%)	
36–49	7 (14.6%)	5 (6.5%)	
Education			
<12 years	29 (60.4%)	36 (46.8%)	N.S.
12 years	15 (31.3%)	33 (42.9%)	
+12 years	4 (8.3%)	8 (10.4%)	
Marital status			
Married	7 (14.6%)	20 (26%)	N.S.
Never married	39 (81.3%)	55 (71.4%)	
Divorced/widowed	2 (4.2%)	2 (2.6%)	
SES			
Index of social prestige (S.D.)	30.77 (10.45)	28.64 (8.57)	N.S.
Race			
African-American	35 (72.9%)	62 (80.5%)	N.S.
White	5 (10.4%)	1 (1.3%)	
Hispanic	7 (14.6%)	13 (16.5%)	
Other	1 (2.1%)	1 (1.3%)	

N.S.: not significant.

** $p < 0.001$.

Table 2
Frequency of prenatal poly-drug use

Poly-drug use	Exposed (<i>n</i> = 48)	Comparison (<i>n</i> = 77)	<i>p</i>
Tobacco use			0.000**
None	11 (23%)	66 (86%)	0.000**
Some (<10 cigarettes per day)	22 (46%)	6 (8%)	
High (≥ 10 cigarettes per day)	15 (31%)	5 (6%)	
Alcohol use			0.000**
None	14 (29%)	50 (65%)	0.000**
Some (<0.5 oz AA per day)	28 (58%)	25 (32%)	
High (≥ 0.5 oz AA per day)	6 (13%)	2 (3%)	
Marijuana use			0.000**
None	29 (60%)	74 (96%)	0.000**
Some (<0.5 joints per day)	14 (29%)	3 (4%)	
High (≥ 0.5 joints per day)	5 (10%)	0	

AA: absolute alcohol content; 0.5 oz. AA is equal to one standard drink.

** $p < 0.001$.

Table 3
Child medical characteristics

Child medical characteristics	Exposed (%) ($n = 48$)	Comparison (%) ($n = 77$)	p
G.A. (weeks)			N.S.
24–27	2 (4.2%)	4 (6.3%)	
28–32	4 (8.2%)	4 (5.2%)	
33–37	9 (18.4%)	15 (18.8%)	
38–42	33 (69.4%)	54 (68.8%)	
Low birth weight	11 (22.9%)	21 (27.3%)	N.S.
Mean B.W. (S.D.)	2740.85 g (913.02)	2863.26 g (906.57)	N.S.
Sex (% male)	27 (56.3%)	39 (50.6%)	N.S.

G.A.: gestational age; low birth weight: <2500 g; N.S.: not significant

B.W.: birth weight.

There were no significant group differences on the infant medical variables (Table 3). The majority of subjects in both groups were born full term; approximately one quarter of each group was low birth weight (<2500 g).

1.2. Procedure

After consenting to the procedure, mothers engaged in a 10-min unstructured play session with their child. The mother was instructed to play with her child as she normally would at home, using a set of attractive, age appropriate toys. Examiners were masked to the dyad's drug exposure status. The interaction was videotaped through a one-way mirror for later coding.

1.3. Measures

The behaviors chosen to operationalize each measured construct were drawn from descriptions used in other studies, using behaviors that could be readily observed in a free-play situation (see Table 4). The constructs in the coding system are divided into those of the mother, child, and dyad. The maternal measures are directiveness, positivity, and sensitivity. The child measures are social initiative and positivity. The dyadic measure is responsiveness. The coding system uses frequency counts of specific behaviors included in each measure. Maternal sensitivity was assessed using Ainsworth's Sensitivity Rating Scale (Ainsworth et al., 1974), which rates maternal sensitivity on a scale from 1 (highly insensitive) to 9 (highly sensitive).

1.4. Data coding

Videotaped data was coded using a computer program for real-time frequency coding (Action Analysis Coding and Transcription, 1996). Reliability was assessed with intra-class correlations, indicating the proportion of total variance in coding due to the coder's agreements on differences between subjects for a given code. Using a sample of 16% of the assessments ($n = 20$), coders' intra-class coefficients ranged from 0.75 (maternal requests fulfilled) to 0.96 (maternal requests) in comparison with the first

Table 4
Play measures

Code	Index variable (intra-class correlations)
Mother codes	
Directiveness	Number of requests (0.96) and toy offers made to the child (0.85)
Positivity	Number of smiles (0.89) and positive vocalizations (0.79)
Sensitivity	Ainsworth's Sensitivity Rating Scale (0.78); rates the mother's sensitivity on a scale of one to nine highly sensitive
Child codes	
Social initiation	Number of gazes to mother (0.90), toy offers (0.82), and coordinated joint attention episode initiations (0.77)
Positivity	Number of smiles (0.91)
Dyadic codes	
Responsiveness	Maternal responsiveness: proportion of child toy offers to which the Mother complies (0.89). Child responsiveness: proportion of maternal requests (0.75) and toy offers (0.93) to which the child complies

Intra-class correlations in parentheses after variable.

author, indicating good reliability (see Table 4). Coders fluent in Spanish and Haitian-Creole coded dyads speaking those languages.

1.5. Data analyses

Data analyses consisted of three multivariate analyses of covariance (MANCOVA) for exposure group differences on maternal, child, and dyadic play variables, controlling for birth weight and SES. We also examined the empirical association of alcohol, marijuana, and tobacco exposure, and maternal age with the outcome variables. These variables were covaried only if they significantly differed between the groups or had a significant association with a given outcome. An alpha level of 0.05 was used for all statistical tests.

2. Results

The mean frequencies and standard deviations of the play variables are listed in Table 5. There was often a substantial degree of variability in the observed behaviors. The correlations are listed in Tables 6 and 7, revealing a moderate degree of association between the child measures. Variables indexing alcohol, marijuana, and tobacco exposure, and maternal age showed no association with either infant, maternal, or dyadic outcome variables.

The MANCOVAs were conducted to evaluate the relationship between cocaine exposure and the play variables, while covarying SES and infant birth weight. The MANCOVAs did not reveal any exposure group differences in the mother, child, or dyadic variables; power to detect differences within this sample ranged from 0.18 to 0.37. However, there was a significant main effect for infant birth weight on the maternal variables [Wilks' $\Lambda = 0.864$, $F(1, 124) = 2.24$, $p < 0.05$, $\eta_p^2 = 0.12$, power = 0.83], but not on the child or dyadic variables. Follow up analyses indicated that low birth weight was associated with

Table 5
Mean frequencies and standard deviations of play interaction variables

Play interaction variables	Exposed (<i>n</i> = 48)		Comparison (<i>n</i> = 77)		<i>p</i>
	<i>M</i>	S.D.	<i>M</i>	S.D.	
Mother					
Directiveness					N.S.
Request	40.40	27.67	35.71	25.67	
Offer toy	11.60	7.90	12.61	7.59	
Positivity					N.S.
Positive vocalization	4.42	5.45	3.49	4.96	
Smile	6.40	5.11	5.31	5.01	
Negative vocalization	3.29	3.48	3.34	4.13	
Sensitivity rating (1–9)	5.85	1.44	5.92	1.61	N.S.
Child					
Social initiative					N.S.
Gaze	19.15	11.44	18.53	11.36	
Offer toy	6.08	6.38	4.53	4.31	
Joint attention	0.60	1.16	0.95	1.72	
Positivity					N.S.
Smile	3.75	3.85	3.79	4.01	
Dyad					
Responsiveness					N.S.
Maternal request fulfilled by child	20%	0.15	18%	0.16	
Maternal offer fulfilled by child	75%	0.24	68%	0.22	
Child offer fulfilled by mother	73%	0.03	71%	0.38	

None of the *p* values were significant; NS: not significant.

Table 6
Correlations between mother and child variables

Child	Child						Mother			
	Gaze	Smile	Toy offer	J.A.	Pos. voc.	Neg. voc.	Request	Offer	Smile	Sensitivity
Gaze	–									
Smile	0.474**	–								
Toy offer	0.421**	0.313**	–							
J.A.	0.347**	0.117	0.165*	–						
Mother										
Pos. voc.	0.144	0.161	0.189*	–0.007	–					
Neg. voc.	0.044	0.029	–0.070	–0.119	0.055	–				
Request	–0.016	0.058	–0.060	0.010	0.085	0.212*	–			
Offer	0.121	0.109	0.381**	0.182**	–0.026	0.059	0.131	–		
Smile	0.196*	0.381**	0.081	0.130	0.383**	0.021	0.054	–0.055	–	
Sensitivity	0.186*	0.182	0.161	0.186*	0.239**	–0.200*	–0.183*	0.012	0.271**	–

J.A.: joint attention; pos. voc.: positive vocalizations; neg. voc.: negative vocalizations.

* *p* < 0.05.

** *p* < 0.01.

Table 7
Correlations between mother, child, and dyadic variables

Dyad	Child						Mother				Dyad		
	Gaze	Smile	Toy offer	J.A.	Pos. voc.	Neg. voc.	Request	Offer	Smile	Sensv.	1	2	3
1	0.167	0.129	0.197*	0.141	0.086	-0.108	0.021	-0.208*	-0.003	0.134	-		
2	0.080	0.009	0.092	-0.043	0.122	-0.173	-0.319**	-0.079	0.136	0.215*	0.130	-	
3	0.080	0.141	0.372**	0.020	0.064	0.050	-0.082	0.108	0.051	0.174	0.066	0.107	-

Dyadic codes: (1) proportion of maternal requests fulfilled by child; (2) proportion of maternal offers fulfilled by child; (3) proportion of child offers fulfilled by mother. J.A.: joint attention; pos. voc.: positive vocalizations; neg. voc.: negative vocalizations; sensv.: sensitivity.

* $p < 0.05$.

** $p < 0.01$.

fewer positive maternal vocalizations [$F(1, 123) = 4.09, p < 0.05; \eta_p^2 = 0.03, \text{power} = 0.51$] and lower sensitivity ratings [$F(1, 123) = 8.30, p < 0.05; \eta_p^2 = 0.06, \text{power} = 0.81$]. There were a greater percentage of maternal requests fulfilled by the child in higher SES dyads [$F(1, 123) = 4.84, p < 0.05; \eta_p^2 = 0.04, \text{power} = 0.65$].

3. Discussion

The purpose of this study was to explore the mother–child social play interactions of toddlers prenatally exposed to cocaine in a sample of 125 dyads. The study used play interaction variables that combined frequency counts and a rating scale to elucidate cocaine exposure group differences. This coding system did not reveal evidence of cocaine exposure effects on the mother, child, or dyadic features of play, although it was sensitive to differences due to birth weight and SES.

3.1. Maternal findings

More directiveness, less sensitivity and less positivity were expected in the exposed groups. The current study used a more objective measure of maternal directiveness (maternal requests) than that used previously with a smaller sample (Hagan & Myers, 1997), but also found no exposure differences. Yet there may be aspects of the maternal request that are not being captured and that indicate important variance in the sample. We hypothesized that the sheer volume of requests would serve as an index of directiveness. Thus, the maternal requests code did not differentiate between outright commands, and requests that give the child more agency, such as those in the form of a question. Moreover, requests can either maintain the child's attention or redirect it. These aspects have been associated with both cognitive and social performance (Beckwith & Rodning, 1996; Hart & Risley, 1995; Landry, Smith, Miller-Loncar, & Swank, 1997), and may be salient to maternal interactive styles in drug using samples.

Few studies have examined sensitivity in cocaine-using mothers; this is the first to have used Ainsworth's Sensitivity Scale (Ainsworth et al., 1974). Contrary to expectations, group differences were not found on this measure. Certainly a play situation allows for a restricted range of maternal behaviors to manifest. Perhaps sensitivity assessments done in the contexts of daily caregiving would be more revealing of any group differences.

The interaction context may provide some explanation as to the overall lack of maternal findings. Hoff-Ginsberg (1991) observed that a toy-play interaction produced the smallest group differences in maternal language. Their robust SES-related differences in maternal speech were most evident in routine caregiving activities, whereas the toy-play setting produced a predominance of directives from all mothers. Given that the drug-exposure effects between demographically similar groups are presumably less robust than SES effects, group differences in maternal verbal interaction style may be particularly elusive in a play setting.

3.2. *Child findings*

The current study's lack of social initiative differences are similar to past research using a rating scale to measure child social behavior (Burns et al., 1997). Research with a slightly older sample found that cocaine exposed 2 year olds showed less social initiative, as indexed by the frequency of acts involving the mother in play, such as offering a toy or vocalizing (Beckwith et al., 1994). Yet vocal bids to the mother were rarely observed in the current sample. Measures of social initiative that incorporate vocalizations may be more applicable to children 2 years of age or older. Our lack of group differences in child positive affect is consistent with findings from other large samples in the literature (Burns et al., 1997; Das Eiden et al., 2002; Ukeje et al., 2001).

3.3. *Dyadic findings*

Consistent with a smaller sample, we found no exposure group differences in dyadic responsiveness (Burns et al., 1997). The coding system utilized was similar to that used with normative samples (Clarke-Stewart, 1973), but similar coding systems have not been used extensively with drug-exposed samples. Further exploration is needed into the quality and appropriateness of responsiveness, and the relationship between responsiveness and developmental outcome, in drug-exposed dyads.

3.4. *Low birth weight and SES findings*

Maternal sensitivity ratings were lower and maternal positive vocalizations were less frequent with low birth weight children. The correlation between sensitivity and positive vocalizations ($r = 0.24$) suggests that the constructs are not independent. It has been proposed that low birth weight infants have a need for specialized parenting styles to facilitate their development (Greenberg & Crnic, 1988). Thus, mothers may use compensatory measures, such as increased directiveness, in an attempt to engage their child (McGrath et al., 1998). We did not find differences in directiveness by birth weight groups. But perhaps the less frequent positive vocalizations and reduced sensitivity reflects a form of altered interaction style in the low birth weight dyads.

In summary, the current study of 18 month olds interaction with their mothers parallels similar studies in finding little evidence of cocaine effects on child, mother, or dyadic behavior. These null findings may be function of the assessment itself; the play interaction may not have elicited the behaviors of interest. Conversely, the high levels of risk factors present in both groups may have not allowed group differences to manifest. Both groups had high proportions of low birth weight infants and mothers of low socioeconomic status, and both of these factors negatively influenced dyadic interaction. Thus, it was within the context of high but not uniform risk status, that subtle cocaine exposure effects were not detected.

Acknowledgements

This study was supported by the National Institute of Child Health and Human Development through cooperative agreement (3 U10 HD021397-17S1) as well as intra-agency agreements with the National Institute on Drug Abuse (NIDA), Administration on Children, Youth, and Families (ACYF) and The Center for Substance Abuse Treatment (CSAT). We would like to thank the families who took part in this research and Susan Gautier, Wendy Griffin, Mary Triolo, and Lisa Eisen for their assistance in data collection; and Genise Vertus for her assistance in data coding. Portions of these data were reported at the biennial meeting of the International Society on Infant Studies (Toronto, Canada, April 2002).

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