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Maternal Into-The-Face Behavior, Shared Attention, and Infant Distress During Face-to-Face Play at 12 Months: Bi-directional Contingencies

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We describe a new maternal intrusion behavior, moving a toy or hand "into-the-face" of the infant, and we investigate its bi-directional associations with infant-initiated shared attention, infant distress, and infant gaze, during mother–infant face-to-face play at 12 months. The play was videotaped split-screen, with infants seated in a high chair. Videotapes were coded on a 1-sec time base for mother and infant gaze (at partner, toy, both, or gaze away); infant distress; and maternal intrusion behavior, "into-the-face." We defined "infant-initiated shared attention" as mother and infant looking in the same second at a toy that the infant-initiated interest in. We documented that maternal into-the-face behavior decreased the likelihood of infant-initiated shared attention, increased the likelihood of infant distress, and decreased the likelihood of infant gazing away. Reciprocally, infant distress and gazing away increased the likelihood of mother into-the-face. In moments when the dyad was engaged in infant-initiated shared attention, mother into-the-face was less likely. This work documents bi-directional contingencies in the regulation of maternal intrusion and infant behavior during face-to-face play at 12 months. We suggest that mother into-the-face behavior disturbs an aspect of the infant's experience of recognition.

By 12 months, infants indicate interest in objects in the environment, share interest in an object with a social partner, and share a partner's interest in an object (Liszkowski, Carpenter, Henning, Striano, & Tomasello, 2004; Rochat, 2001). Infants are particularly

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interested in objects that they attend to with others (Baron-Cohen, 1995; Bruner, 1982; Striano, Reid, & Hoehl, 2006; Tomasello, 1999). For infants as well as adults, simply attending together may hold special significance, amplifying memories, emotions, and learning (Shteynberg, 2015).

One form of attending together occurs when mothers join the infant's focus of attention on an object. Such maternal joining constitutes an important maternal scaffolding of the infant's interest in the environment and the infant's ability to coordinate interest in objects with interest in other people, typically referred to as joint attention (Bakeman & Adamson, 1984; Dunham & Dunham, 1995; Landry, Smith, & Swank, 2006). Parents carry a large share of the responsibility to facilitate shared interest in objects. Something special happens when the parent joins the infant's focus. In this moment, the infant's initiative toward an object in the environment is recognized, shared, and given interpersonal significance. In this study of mother–infant face-to-face communication at infant age 12 months, we examined "infant-initiated shared attention," which we defined as maternal joining of the infant's focus of attention on a toy. In our use, when the infant indicates interest in a toy, and the mother directs her attention to the same toy in the same second, she joins the infant's focus in "infant-initiated shared attention."

A salient counter-point to shared attention is the occurrence of moments of maternal intrusion which may disturb or inhibit shared attention. These moments of maternal intrusion have been variously described, for example, as redirecting (Landry et al., 2006); attention-switching (Dunham & Dunham, 1995); or introducing new objects, or initiating play, while the infant's attention is still on another object (Leyendecker, Lamb, Fracasso, Scholmerich, & Larson, 1997). In this study, we describe the maternal intrusion behavior of movements directly "into-the-face" of the infant with a hand or toy. This is a dramatic maternal intrusion behavior which, to our knowledge, has not previously been specifically examined.

We hypothesized that maternal into-the-face behavior is an intrusion which inhibits shared attention, increases the likelihood of infant distress, and disturbs the infant's gaze patterns. We investigated this hypothesis within a dyadic systems view of communication in which each person's behavior is seen as contingently coordinated with that of the other (Beebe et al., 2016; Fogel, 1993; Tronick, 2007). Thus, we reciprocally hypothesized that infant behaviors of distress and gazing away may increase the likelihood of maternal into-the-face behavior. Although the interpersonal contingency process is proposed to be bi-directional, it is not necessarily symmetrical: Mothers typically exhibit greater flexibility and range than their infants, and mothers are more likely to coordinate with, or adjust to, infant behaviors than infants are with mothers (Beebe et al., 2016).

Infant-initiated shared attention

By 9 months of age, infants begin developing a triangulation among self, partner, and object. By 1 year, they begin to display joint attention and social referencing, including imperative gestures such as pointing (Liszkowski et al., 2004). By this time, infants also typically develop independent mobility, increased verbalization and reaching (Rochat, 2001). These abilities enable infants to share interest in an object with a social partner. As development progresses, social play with toys contributes to the capacity to pretend, to adopt roles, and ultimately to create symbolic dialogues.

One central developmental achievement that emerges at this time is the capacity for attention to the person and the object, typically termed joint attention. Joint attention tasks usually include purposefully attracting the infant's gaze to an object in a controlled manner, as defined by the procedure in an experimental design. Examples of these include active toy tasks (Butterworth & Adamson-Macedo, 1987) and goal detection tasks (Phillips, Baron-Cohen, & Rutter, 1992). Most of the joint attention tasks examine the infant's ability to join the partner's focus of attention on an object, which is often used as an index of developmental progress.

In contrast, we are interested in shared attention, which we distinguish from joint attention. However, these terms are not well distinguished in the literature (see, e.g., Fasel, Deák, Triesch, & Movellan, 2002). Deák and Triesch (2006, p. 332) defined shared attention as "redirecting attention to match another's focus of attention, based on the other's behavior." While we define the term shared attention similarly to Deák and Triesch (2006), sharing attention on a common object, our observations take place during naturalistic face-to-face play, rather than within an experimental paradigm. In our study, mothers and infants are free to pick up toys. Although shared attention could be examined from the vantage point of either partner joining the other's focus, here we examine the mother joining the infant's focus of attention on an object in the same second, hence our specification of *infant-initiated* shared attention.

Similar discussions of the mother's contribution to infant capacity for shared attention can be found in the literature. For example, Landry et al. (2006) considered maternal support of infant focus of attention, or maintaining of infant attention focus, to be a form of positive responsiveness, whereas redirecting was considered a lack of responsiveness. Dunham and Dunham (1995) distinguished between maternal "infant-following" strategies in moments of shared attention, versus maternal "attention-switching" strategies. Our concept of infant-initiated shared attention is similar to Dunham and Dunham's (1995) concept of maternal "infant following." Dunham and Dunham (1995) note that maternal ability to follow the infant's play trajectory, as opposed to interfering with it, or attempting to shape it, is associated with increased lexical development. Tomasello and Farrar (1986) showed that maternal verbal attention to the infant's object, rather than drawing attention to her own object, facilitated infant language acquisition.

Bigelow, MacLean, and Proctor (2004), and Bigelow et al. (2010) note that maternal sensitivity to the infant's focus within joint attention may be key to the advances in play that are facilitated by joint attention. Examining 1-year-old infants and their mothers during a joint attention task, Bigelow et al. (2004) found that maternal "following," rather than directing, the infant's play interests were associated with more advanced play. When engaged with toddlers, mothers who were less directive in joint attention episodes had toddlers who sustained joint attention for longer periods (Bigelow et al., 2010). Maternal following of infants' play interests allows play within joint attention to be child-centered, which enables infants' interest in play to be engaged and maintained.

Maternal ability to join infant attentional focus is a critical scaffolding of the infant' interest in the object world. It is likely one precursor to shared subjective mental states and may scaffold a number of other related developmental achievements, such as joint attention, mentalization, and more elaborate play exploration (Landry, Garner, Swank, & Baldwin, 1996; Vygotsky, 1978). In infant-initiated shared attention, the mother recognizes the infant's initiative and agency by indicating with her actions

something like, "I see what you see; I know what you know. You can see that I see what you see" (Harrison, 1998; Sander, 1995; Winnicott, 1986). The concept of shared attention encompasses the individual's awareness of the partner's direction of attention and includes the idea that the partner's awareness can be sought, joined, or affected (Hobson, 2004; Slaughter & McConnell, 2003). It is one collaborative process through which children and their parents negotiate shared meaning (Tomasello, Carpenter, Call, Behne, & Moll, 2005).

Maternal intrusion

The literature documents that shared attention, defined as maternal attention-following, or maintaining infant attentional focus, is optimal in interaction. In contrast, forms of disruption of shared attention are variously described as redirecting the infant's attention, attention-switching, or failing to follow the infant's play trajectory. These behaviors through which the mother disrupts shared attention have also been used to define maternal intrusion. For example, Leyendecker et al. (1997) coded maternal intrusions as occasions when the mother introduced new objects to the play, or initiated social play while the toddler's attention was still fixed on another object. Nicol-Harper, Harvey, and Stein (2007) defined maternal intrusion with the flavor of interruption: "actions that cut across, take over or disrupt the infant's activity" (pp. 163).

Earlier in development, during mother–infant face-to-face play at 4–6 months, mothers can also be observed redirecting the infant's focus of attention (Mason, Goldstein, & Schwade, 2016). When mothers are "sensitive," that is, engage with infant's object of focus, infants look more at mother's objects when mothers are engaged, thus joining mother's focus of attention. In contrast, infants of high redirective mothers, who frequently interrupt the infant's focus, look more at the mother's objects when the mother is not engaged, not sharing her focus (Mason et al., 2016). Thus redirecting mothers, who can be considered more intrusive, seems to disturb shared attention; less intrusive mothers and their infants generate more shared attention.

In this study, we describe a new measure of maternal intrusion during mother–infant play at 12 months, *into-the-face* behavior. In this behavioral pattern, the mother physically places her hand, an object, or her own face into or very near the infant's face. We argue that maternal into-the-face behavior is an important intrusion behavior during mother–infant face-to-face play at 12 months, interfering with maternal following and joining the infant's focus of attention.

Infant distress

Infant distress is a central issue in early development. For example, higher infant distress at 4 months interferes with mother–infant and father–infant synchrony (Feldman, 2006) and predicts 12-month disorganized attachment (Beebe et al., 2010). Higher negative affect at 24 and 36 months is associated with less maternal sensitivity and stimulation, more maternal depressive symptoms, greater likelihood of insecure attachment, and more problematic outcomes at 4.5–6 years (Leerkes, 2011; NICHD Early Child Care Research Network, 2004). Greater maternal sensitivity to infant distress (but not to infant nondistress) at 6 months is associated with increased likelihood of secure (versus insecure) infant attachment (McElwain & Booth-LaForce, 2006), and fewer

infant behavior problems and greater social competence at 12 and 24 months (Leerkes, Blankson, & O'Brien, 2009).

Bi-directional associations between maternal intrusion and infant negative affect were documented by Rystad (2014). More infant negative affect at 12 weeks predicted higher maternal intrusion at 18 weeks; higher levels of maternal intrusion at 18 weeks predicted more infant negative affect at 24 weeks. The Rystad study, as well as Beebe et al.'s (2016) documentation of the bi-directional regulation of mother and infant facial and vocal affect, and of maternal spatial patterns in relation to infant head orientation patterns, provides a rationale for our bi-directional hypothesis that maternal intrusion may increase infant distress, and reciprocally infant distress may increase maternal intrusion.

Approach

This study used a dyadic systems view of bi-directional regulation of mother and infant behavior in face-to-face interaction and a second-by-second microanalytic coding of videotaped interactions (Beebe et al., 2010, 2016). A time-series approach to measuring interpersonal contingency allowed for comparisons of events as they unfolded in time, and for an examination of how each partner's behavior predicted that of the other. This approach was used to better understand mother–infant face-to-face interaction in the context of infant-initiated shared attention, maternal intrusion of into-the-face behavior, and infant distress at 12 months.

We chose to study mother–infant face-to-face interaction in the mild stress paradigm of play while the infant was seated in a high chair with toys available. This paradigm challenges the dyad to find a way to play when the infant's freedom of movement is restricted, a common occurrence at 12 months. Challenge or perturbation is known to amplify the aspects of a system's organization. That is, a moderate stressor challenges the person to cope and thus may reveal more clearly the person's adaptation. Common examples are the still-face paradigm (Tronick et al., 1978) and the separation–reunion paradigm of attachment assessment (Ainsworth, 1978).

Hypotheses

We hypothesize that maternal into-the-face behavior (1) disrupts infant-initiated shared attention on the infant's object, (2) increases the likelihood of infant distress, and (3) increases the likelihood of infant gaze aversion. Reciprocally, we hypothesize that (1) infant-initiated shared attention decreases the likelihood of maternal into-the-face behavior, (2) infant distress increases the likelihood of maternal into-the-face behavior, and (3) infant gaze aversion increases the likelihood of maternal into-the-face behavior.

METHOD

Participants

Recruitment

Within 24 h of delivering a healthy, full-term, first-born singleton infant without major complications, 152 mothers from a large urban medical center gave permission

to be contacted regarding a study of "infant social development," involving 4- and 12-month laboratory visits for videotaping. Mothers were at least 18 years old, married or living with partner, with telephone. Of these 152 mothers, 132 agreed to participate in the study at infant age 4 months.

At 12 months, 84 mother–infant pairs returned for assessment. This study concerns only the 12-month visit. Many efforts were made to retain subjects for the 12-month follow-up. The main reason given by mothers for not attending was that they had returned to work. The high attrition is also likely influenced by high rates of urban mobility. The attrition rate is similar to that of Jaffe et al. (2001), for a sample collected in the same hospital, with the same criteria, a half-decade earlier. One dyad of the 84 was not included in the data analysis because the audio channel was not adequate, yielding a final $N = 83$. The 83 dyads who returned at 12 months did not differ from the 48 who did not return in maternal age or ethnicity, or infant gender, as seen in Table 1. However, those mothers who returned had received more education than those who did not return ($\chi^2(1, N = 132) = 3.995$, $p = .046$).

The study was conducted according to guidelines of the Declaration of Helsinki, with written informed consent obtained from the parent before any data collection. All procedures involving human subjects were approved by the New York State Psychiatric Institute Institutional Review Board.

Demographic description

Mothers who returned at 12 months ($N = 83$) had a mean age of 29.59 ($SD = 6.18$, range = 18–43), with ethnicity 54.2.0% White, 28.9% Hispanic, 16.9% African American. Completion of some college or more characterized 66.7% of mothers. Of the 83 dyads, 37 infants (44.6%) were female.

TABLE 1
Demographic Differences Between Participants Who Did and Did Not Return at 12 Months (T2)

	Returned at T2 (N = 83)	*Did not return at T2 (N = 49)*	*Statistic*	*p-Value*
Mother ethnicity				
White	45	27	0.107[a]	0.948
Black	14	9		
Hispanic	24	13		
Mother education				
No college	28	26	3.995[a]	0.046
Some college or more	55	23		
Child sex				
Male	46	28	0.000[a]	0.990
Female	37	21		
Mother age				
Mean age	29.59 ± 6.18[b]	28.10 ± 7.20	1.557[c]	0.214

[a]Chi-squared.
[b]Mean ± *SD*.
[c]ANOVA.

Procedure

Scheduling of 12-month laboratory videotaping took into account mothers' preferences so as not to disturb infants' eating/sleeping patterns. Ample time was set aside for infants to feed or nap in the laboratory if necessary. Mothers and infants participated in a face-to-face interaction with a standard set of toys. The infant was seated in a high chair opposite the mother, who was instructed to play with her infant as she would at home, for 10 min. A special effects generator created a split-screen view from input of two synchronized cameras focused on head, upper torso and hands of mother and infant.

Behavioral coding of mother–infant interaction

The first 180 sec of uninterrupted continuous play minutes[1] of videotaped mother–infant interaction were coded on a *1-s time base* by coders blind to the study's hypotheses. Using Tronick and Weinberg (1990) timing rules, if more than one behavior occurred in the same second, the behavior occurring in the second half of the second was privileged (Beebe et al., 2010; Tronick, 1989). Mothers and infants were coded independently for mother/infant gaze, maternal intrusion behavior into-the-face, and infant behavioral distress.

Gaze

Gaze was coded for each partner separately in the following categories: (1) look at partner's face, (2) look at object, (3) look simultaneously at partner and object, (4) gaze off (off partner and/or object.) Look at object was further differentiated by who initiated attention to the object, mother ("mother's object"), or infant ("infant's object"). Initiation of attention to the object could occur via gaze, vocalization, or gesture. Coder reliability was assessed at three time points to prevent coder "drift," yielding a mean Cohen's kappa for infant gaze = .74 (range .62–.91) and mother gaze = .78 (range .71–.82).

For data analysis, we generated two variables from these codes: (1) *look at partner* coded dichotomously for look versus not-look at partner (versus all other codes); (2) *infant-initiated shared attention,* a dyadic variable, coded dichotomously whenever infant and mother were both gazing in the same second *at an object on which the infant initiated attention.*

Mother-into-the-face

Maternal into-the-face behavior was coded dichotomously as presence or absence of maternal movement of an object or hand into close proximity to the infant's face (mean kappa .93; range 1.0–.66). Although only 58 of the 83 mothers showed into-the-face behavior, data from all dyads were used in the data analyses. There

[1]A 2–3 min sample of behavior is standard in the literature (Beebe et al., 2010; Cohn & Tronick, 1988; Field, Healy, Goldstein, & Guthertz, 1990); small samples of <5 min are as robust as longer ones (Ambady & Rosenthal, 1992); session-to-session reliability in mother–infant interaction is robust (Cohn & Tronick, 1989; Moore, Cohn, & Campbell, 1997; Weinberg & Tronick, 1991; Zelner, Beebe, & Jaffe, 1982).

were no significant differences between the mothers who showed any into-the-face behavior and those who did not, in infant gender ($\chi^2 = .304$, $p = .582$), mother education ($\chi^2 = 1.517$, $p = .218$), age, ($t = 1.653$, $p = .102$), or ethnicity ($\chi^2 = 4.738$, $p = .094$).

Infant distress

Infant distress was coded dichotomously for the presence/absence of any of the following behaviors: facial distress, vocal distress (fuss/whimper, angry-protest, cry), back arch, banging the body against the back of the chair, flinging the body around in the chair, postural limpness, and postural escape (twist body fully away from mother/trying to get out of the chair) (mean kappa .82; range .78–.86).

Data analysis: multilevel time-series models

To create indices of interpersonal contingency, traditional time-series approaches model each dyad individually and enter model coefficients into analyses of variance. Multilevel time-series approaches model the group as a whole, creating estimates of fixed effects in the sample while accounting for individual variation in those effects. Advantages of this approach include more appropriate statistical assumptions, more accurate estimates of parameters, and increased power.[2]

The SAS PROC GLIMMIX program was used to estimate "random" (individual differences) and "fixed"[3] (common model) effects on patterns of interpersonal contingency of behavior over 180 sec (Cohen, Chen, Hamagami, Gordon, & McArdle, 2000; Littell, Miliken, Stoup, & Wolfinger, 1996). We performed logistic regressions because our variables are dichotomous. For details of statistical models, see Chen and Cohen (2006). These analyses used all 180 sec coded from videotape for each individual. Repeated observations on individuals are the basic random data, just as in cross-sectional data single individuals are the basic units of analyses. Fixed effects indicate average effect over the full sample so that it is possible to estimate the extent to which

[2]Multilevel models are designed to address patterns over time (here the course of behavior second by second). Compared with traditional time-series techniques, multilevel models (Singer & Willett, 2003) have more power, take into account error structures, and estimate individual effects with empirical Bayesian (maximum-likelihood) techniques (rather than ordinary least squares), which take into account prior distributions. Because the prior probability of error is greatest for the extreme parameters, this method tends to pull in such extremes. Advantages of this approach include (1) multiple time series (in our case, self- and interactive contingency) can be modeled simultaneously, (2) an average effect of key parameters (e.g., infant behavior contingent on mother behavior) is estimated for the group and allows the investigator to ask how that group mean changes in the context of other factors (such as infant gender), (3) control variables and their conditional effects can be included as necessary, (4) potential nonlinear relations can be examined in the same analyses, and (5) more appropriate statistical model assumptions are made.

[3]A random effect is the term used for identifying the differences in a variable (function or association) among the study subjects. These always include variation in the mean of the dependent variable across observations, and variation in the variance of the dependent variable across observations; they usually include variation in the linear change in the dependent variable over time, and in our case it includes between-dyad variation in the autoregressive effect. A fixed effect is the average association across study units (in our case, dyads), just as it would be in an ordinary regression analysis. These average effects will account for some fraction of the random effects, just as in an ordinary regression analysis the predictors account for some fraction of the variance in the dependent variable.

a single overall model accounts for the individual differences reflected in the random model. Tests of hypotheses used fixed effects.[4]

Our analyses used a moving 7-sec window across time. We chose this window because pilot data indicated that it adequately captured interpersonal contingencies associated with maternal intrusion and infant distress (Beebe et al., 2015).

Given a maternal (or infant) behavior at t_0, we aimed to predict the partner's subsequent behaviors at t_{+1} through t_{+6}. Although this was our aim, using separate models to evaluate the association between, for example, mother into-the-face at t_0, and the probability of infant distress at each subsequent time point, for example t_{+1}, would not allow for the control of infant distress at the other time points in the window (t_{+2} – t_{+6}). To ensure that the probability of infant distress at each time point controlled for the probability of infant distress at all other time points, the model was reconceptualized to include infant distress at all six time points within one model. The model predicted the probability of infant behavioral distress at t_0 given mother into-the-face occurred at t_{-1} (1 sec prior), t_{-2} (2 sec prior), etc., resulting in the basic equation:

$$\frac{\text{Log } P}{1-P} = B_1\text{MITF}_{t-1} + B_2\text{MITF}_{t-2} + B_3\text{MITF}_{t-3} + B_4\text{MITF}_{t-4} + B_5\text{MITF}_{t-5} + B_6\text{MITF}_{t-6}$$

where P = probability of infant behavioral distress at t_0 and MITF = mother into-the-face.

This model generated estimates for the association of mother into-the-face at six prior lags (six prior seconds) and subsequent infant behavioral distress at t_0. Consistent with the aims of the study, the results of this model were then translated as follows: given mother into-the-face at t_0, the probability of infant distress occurring at t_{+1} – t_{+6}. This same strategy was used for all analyses. Because each second is separately assessed in the same equation, each second controls for every other second. These models evaluate each second and therefore do not address the question of the duration of behavior.

The modeling process for predicting the time-varying behavior in question (e.g., infant distress) considered demographic variables (maternal ethnicity, age, education, and infant sex), mother and infant behavior variables as described above, and all possible two-way interactions between demographic and behavior variables. Because demographic variables and their conditional associations with behavior variables were included as a check on the assumption that these would not alter the basic findings, when these effects were not statistically significant, they were dropped from subsequent and final models. Main effects were retained in the model regardless of significance when any conditional effect involving that variable was statistically significant. Because the effects of behavior variables were the focus of hypotheses, all main effects of behavior variables were included in the model regardless of significance. The final model included the simplest model consistent with the data according to a goodness-of-fit test (F-test) for these maximum-likelihood estimates (Chen & Cohen, 2006).

[4]The first step in these analyses examined between-subject differences ("random effects") in mean level, linear slope over time, mean by time, and the interindividual difference term in the auto-regression parameter. These random models were the basis for examination of fixed effects.

Data from all 83 dyads entered the multilevel models, not just the 58 with the presence of mother into-the-face behavior (those dyads with zero into-the-face seconds were a part of the analysis). By analyzing all 83, we examined the process of mother into-the-face behavior in all the dyads we studied. If we had limited the analysis to only those mothers who showed any into-the-face behavior, we would have examined this process only in mothers (and their infants) who showed this behavior. The degrees of freedom of the multilevel models are taken from the level of the second, not the level of the individual. With $N = 83$ dyads $\times$ 180 sec per individual, we had 14,940 sec of data per variable, thus 14,000 degrees of freedom for every model, ample power to address our questions.

The results presented below translate the structure of the equations described above so as to examine the following associations: (1) The association of mother behavior with subsequent infant (and dyadic) behavior was evaluated as the likelihood that mother-into-the-face at t_0 predicts (a) dyadic infant-initiated shared attention, (b) infant behavioral distress, and (c) infant gaze aversion, at $t_{+1} - t_{+6}$; (2) the association of infant (and dyadic) behaviors with mother into-the-face behavior was evaluated as the likelihood that, at t_0, (a) infant-initiated shared attention, (b) infant behavioral distress, and (c) infant gaze aversion, predict mother into-the-face at $t_{+1} - t_{+6}$.

RESULTS

We first present descriptive information on mother and infant behaviors. We then evaluate a bi-directional model of interpersonal contingencies with multilevel time-series models to test our hypotheses. We evaluate whether maternal intrusion into-the-face predicts infant-initiated shared attention, infant distress, and infant gaze aversion across the following 6 sec; and reciprocally, whether infant-initiated shared attention, infant distress, and infant gaze aversion predict maternal intrusion into-the-face across the next 6 sec.

Descriptive information

The mean duration of infant-initiated shared attention on infant's object was 5.86 sec (*SD* 7.8 sec); of infant distress was 1.14 sec (*SD* .416 sec); of infant gaze-off mother was 7.20 sec (*SD* 10.23 sec) (a few babies had very *long gaze off* up to 109 sec). Mother into-the-face is a brief, fleeting event (mean duration = 1.26 sec, *SD* .91 sec) which occurred in only 2.74% of the seconds. Nevertheless, 58 of the 83 mothers (69.9%) used into-the-face behavior at least once. Of 58 mothers, 37 had a frequency between 1 sec and 5 sec of into-the-face behavior, 10 had between 6 and 10 sec, 11 had 11 sec or more; the frequency range was 0–43 sec. With regard to number of infants showing distress, infants of mothers with frequency $\geq$6 sec of into-the-face behavior did not significantly differ from infants of mothers with frequency less than 6 sec of into-the-face behavior ($\chi^2(1, N = 58) = 0.000$, $p = 1.0$).

Mother into-the-face and infant-initiated shared attention: bi-directional contingencies

Mother into-the-face behavior in the current second (t_0) decreases the likelihood of infant-initiated shared attention on infant's toy at 1, 2, and 4 sec later, as seen in

TABLE 2
Mother Into-The-Face and Infant-Initiated Shared Attention: Bi-Directional Effects

	β	$SE\ \beta$	p
Mother → Infant			
t_{+1}	**−.260**	**.118**	**.029**
t_{+2}	**−.322**	**.141**	**.022**
t_{+3}	−.156	.139	.262
t_{+4}	**−.302**	**.145**	**.038**
t_{+5}	−.194	.136	.154
t_{+6}	.002	.111	.985
Infant → Mother			
t_{+1}	**−.446**	**.231**	**.053**
t_{+2}	−.087	.255	.732
t_{+3}	−.026	.254	.918
t_{+4}	−.053	.253	.834
t_{+5}	−.049	.251	.844
t_{+6}	−.143	.220	.516

Note. Multilevel time-series models used a moving 7-sec window (see Method). Significant variables are bolded. The results are interpreted as follows: given mother into-the-face behavior (or infant behavior) at t_0, the equation estimates the probability that the partner's subsequent behavior in question occurs at t_{+1} through t_{+6}. Mother → Infant indicates that mother into-the-face at t_0 predicts infant behavior at $t_{+1} - t_{+6}$, and vice versa for Infant → Mother.

Table 2. To illustrate, the negative association between mother into-the-face and infant-initiated shared attention at t_{+1} ($\beta = -.260$, $p = .029$) indicates a significant decrease in infant-initiated shared attention 1 sec following the occurrence of mother into-the-face at t_{+1}. Reciprocally, infant-initiated shared attention in the current second (t_0) decreases the likelihood of mother–infant into-the-face behavior 1-sec later, as seen in Table 2. These results are visually illustrated in Figure 1.

Mother into-the-face and infant distress: bi-directional contingencies

Mother into-the-face in the current second (t_0) increases the likelihood of infant distress 1, 2, and 3 sec later, as seen in Table 3. However, a significant interaction effect of infant sex at 2 sec later (t_{+2}) shows that, at $t_{+2,}$ mother into-the-face

Mother Into-The-Face at t_0 → Infant Behavior							Infant Behavior at t_0 → Mother Into-the-Face						
	t_{+1}	t_{+2}	t_{+3}	t_{+4}	t_{+5}	t_{+6}		t_{+1}	t_{+2}	t_{+3}	t_{+4}	t_{+5}	t_{+6}
MITF→ Shared Atten	↓	↓		↓			Shared Atten→MITF	↓					
MITF→ Infant Distress	↑	↑[a]	↑				Infant Distress→MITF	↑					
MITF→ Infant Gz Off	↓		↓				Infant Gz Off→MITF		↓	↑			↑

Figure 1 Bi-directional effects: mother into-the-face, infant-initiated shared attention, infant distress, and infant gaze off. 1. Arrows indicate which seconds showed significant effects, and the direction of the effect on the relevant behavior, increased (↑) or decreased (↓). 2. MITF = Mother-into-the-face behavior; atten = attention; gz = gaze. [a]The presence of MITF at t_0 increased distress for male infants at t_{+2}, but not female infants.

TABLE 3
Mother Into-The-Face and Infant Distress: Bi-directional Effects

	β	$SE\ \beta$	p
Mother → Infant			
t_{+1}	**.339**	**.113**	**.003**
t_{+2}[a]	**.553**	**.134**	**< .001**
t_{+3}	**.287**	**.127**	**.024**
t_{+4}	.018	.132	.892
t_{+5}	−.019	.132	.885
t_{+6}	.169	.116	.146
Infant → Mother			
t_{+1}	**.536**	**.242**	**.027**
t_{+2}	−.481	.310	.120
t_{+3}	−.002	.307	.994
t_{+4}	−.000	.302	.999
t_{+5}	.359	.297	.227
t_{+6}	.308	.246	.212

Note. Significant values are bolded.
[a]Male and female infants significantly differ at t_{+2} ($\beta = -.593$, $p = .020$), with gender coded male: 0, Female: 1. Mother into-the-face significantly predicts infant distress at t_{+2} for male infants ($\beta = .553$, $p < .001$). However, mother into-the-face does not significantly predict infant distress at t_{+2} for female infants ($\beta = -.040$, $p = .868$).

predicts increased likelihood of distress for male infants only. This was the only equation and the only time point that showed a significant effect of a demographic variable. Reciprocally, infant behavioral distress in the current second (t_0) increases the likelihood of mother into-the-face behavior 1-sec later, as seen in Table 3 and Figure 1.

Mother into-the-face and infant gaze off: bi-directional contingencies

Mother into-the-face in the current second (t_0) decreases the likelihood of infant gazing away from the mother, that is, increases the likelihood of infant looking at the mother, at 1 and 3 sec later. Reciprocally, infant gazing away in the current second (t_0) decreases the likelihood of mother into-the-face behavior 2 sec later, but increases its likelihood 3 and 6 sec later, as seen in Table 4 and Figure 1.

In summary, we documented that mother into-the-face behavior decreased the likelihood of infant-initiated shared attention, increased the likelihood of infant distress, and decreased the likelihood of infant gaze away. Reciprocally, infant distress and gazing away increased the likelihood of mother into-the-face behavior. However, at moments that the dyad was engaged in infant-initiated shared attention, mother into-the-face was less likely.

Evaluating the number of significant findings relative to the number of equations run, for infant-initiated shared attention and infant distress, half the equations were significant when considering the direction of contingency mother → infant, and 16.5% were significant when considering the direction of contingency infant → mother. However, considering infant gaze, the proportion was one-third for mother → infant, and one-half for infant → mother.

TABLE 4
Mother Into-The-Face and Infant Gaze Off: Bi-directional Effects

	β	$SE\ \beta$	p
Mother → Infant			
t_{+1}	**−.248**	**.124**	**.046**
t_{+2}	−.003	.138	.982
t_{+3}	**−.336**	**.128**	**.009**
t_{+4}	−.235	.131	.074
t_{+5}	.143	.145	.325
t_{+6}	.013	.134	.925
Infant → Mother			
t_{+1}	.017	.145	.910
t_{+2}	**−.329**	**.150**	**.028**
t_{+3}	**.381**	**.165**	**.021**
t_{+4}	−.291	.152	.056
t_{+5}	−.085	.157	.586
t_{+6}	**.420**	**.163**	**.010**

Note. Significant values are bolded.

DISCUSSION

We investigated ways in which mothers and infants jointly regulate the behaviors of maternal intrusion into-the-face, infant-initiated shared attention, and infant distress, during face-to-face play at 12 months. We discuss the ways in which mother and infant both participate in bi-directional regulation of (1) mother into-the-face and infant-initiated shared attention, (2) mother into-the-face and infant distress, and (3) mother into-the-face and infant gaze.

The regulation of mother into-the-face and infant-initiated shared attention: bi-directional contingencies

Mother into-the-face predicted lowered likelihood of infant-initiated shared attention on the infant's toy

Shared attention on the infant's toy can be construed as one important goal of play at 12 months (Bigelow et al., 2004; Landry et al., 2006; Leyendecker et al.,1997; Nicol-Harper et al., 2007). In our measure of infant-initiated shared attention, the infant takes initiative by gazing at, pointing at, or vocalizing about a toy; and the mother in the same second follows the infant's initiative and gazes at that same toy. It is a moment in which the mother shares her infant's interest in the toy and recognizes the infant's initiative, agency, and focus of attention.

We confirmed our hypothesis that mother into-the-face behavior decreases the likelihood of infant-initiated shared attention on the infant's toy. We propose that this maternal behavior privileges the mother's initiative over that of the infant and potentially overrides the infant's volition and agency. In this process, the mother loses an opportunity to show that the activity of her infant's mind is acknowledged and shared.

Mason et al. (2016) observed a similar association at 5 months. In their study, maternal redirectiveness was associated with lowered infant joining the mother's focus

on an object. Both studies thus documented an opposition between maternal intrusion and forms of shared attention.

Infant-initiated shared attention on the infant's toy predicted lowered likelihood of mother into-the-face

Our hypothesis that infant-initiated shared attention on the infant's toy decreases the likelihood of mother into-the-face behavior was confirmed. We propose that shared attention on the infant's toy is not only an important goal of the play, but it is also gratifying and fun for both partners: The play is working well. Thus, we infer that the mutual satisfaction of shared attention seems to render mother into-the-face behavior less necessary.

The regulation of mother into-the-face and infant distress: bi-directional contingencies

Mother into-the-face predicted infant distress

We confirmed our hypothesis that mother into-the-face behavior increases the likelihood of infant distress. The likelihood of infant distress was increased 1, 2, and 3 sec later. We infer that mother into-the-face is an intrusive event. It crosses the usual boundary of the private space directly in front of the face and is likely overwhelming for the infant. It is striking that, at the exact same moments (1 sec and 2 sec following mother into-the-face), not only was the likelihood of infant distress increased, but the likelihood of infant-initiated shared attention was also decreased, as discussed above.

However, in one exception, 2-sec following maternal into-the-face behavior, female infants did not respond with more distress. One possibility is that female infants at this moment inhibit the "release" of distress that male infants more easily show, consistent with findings that female children show more internalizing behaviors and males more externalizing behaviors (Card, Stucky, Sawalani, & Little, 2008; Daughters et al., 2009; Kramer, Krueger, & Hicks, 2008). Another possibility is that girls mind this maternal behavior less because they feel less threatened by such intrusions, consistent with studies that show less distress to maternal intrusion in infant girls than boys (Ispa, Cook, Harmeyer, & Rudy, 2015; Lindsey, Caldera, & Colwell, 2005; Robinson, Little, & Biringen, 1993).

Infant distress predicted mother into-the-face

We also confirmed our hypothesis of a bi-directional contingency process: Not only did mother into-the-face increase the likelihood of infant distress, but infant distress reciprocally increased the likelihood of mother into-the-face. This is a maladaptive "positive feedback" loop in which each person's behavior escalates that of the other.

The infant's distress likely upsets the mother, provoking her to move into the infant's face. Maternal into-the-face behavior may be an attempt to distract the infant, or to redirect the infant's attention back to her, or to a toy she is offering, but instead it increases the likelihood of infant distress. Infant distress followed by mother into-the-face suggests maternal difficulty tolerating infant distress. The way in which a mother responds to her infant's distress has been associated with important developmental outcomes such as attachment styles (Beebe et al., 2010; Leerkes, Parade, & Gudmundson, 2011).

The regulation of mother into-the-face and infant gaze: bi-directional contingencies

Mother into-the-face predicted decreased likelihood of infant looking away

We hypothesized that mother into-the-face is an intrusive event for the infant which leads to increased infant gaze aversion as a form of self-regulation. We had reasoned that the infant would resist this intrusion by looking away in subsequent moments. This hypothesis was not confirmed. Instead we found the opposite: Following a moment of mother into-the-face behavior, the likelihood of infant looking away decreased; that is, the likelihood of infant gaze at mother, an object, or both, was increased.

In retrospect, we understood this result in the following way. The infant cannot easily look away when an object is thrust into his face. Instead, the infant was more likely to look at mother, the toy moving into his face, or both. We interpret this increased likelihood of looking as a form of infant vigilance. We note that maternal into-the-face behavior predicted not only increased likelihood of infant looking but also increased infant distress, discussed above. These two findings together suggest infant distressed vigilance. The fact that mother into-the-face behavior increased the likelihood that infants would look at mother, a toy, or both may encourage the mother's into-the-face behavior, despite its problematic outcomes.

Infant looking away predicted first decreased, then increased, likelihood of mother into-the-face

We also hypothesized that infant gaze aversion is difficult for mothers and may precipitate mother into-the-face behavior. This hypothesis was partially confirmed. Infant gaze aversion decreased the likelihood of mother into-the-face 2 sec later, but increased its likelihood 3 sec and 6 sec later.

The sequence of infant gaze aversion predicting mother into-the-face is complex. Following the infant's gaze aversion, in the 1st second, mother's likelihood of into-the-face was neither increased nor decreased; she seemed to wait. In the 2nd second, her likelihood of into-the-face behavior decreased. This finding seems to indicate a maternal effort to hold back, to tolerate the infant's gaze away, perhaps to see whether the infant could return to gazing at her. But by the 3rd second following the infant's gaze aversion, the likelihood of mother into-the-face behavior increased. We conjecture that the mother loses the ability to tolerate the infant's sustained gaze away by this point, and she seeks re-engagement. At seconds 4 and 5, mother's likelihood of into-the-face was neither increased nor decreased; she seemed to wait. But by second 6, the likelihood of into-the-face again increased. This sequence suggests the complicated process that mothers may experience as they struggle to balance waiting for the infant to return, and seeking visual re-engagement.

This is a bi-directional contingency process. The infant's gaze aversion initially led to maternal restraint, but eventually this restraint gave way to "going after"' the infant through increased likelihood of into-the-face behavior. Reciprocally, mother into-the-face decreased the likelihood of infant of gazing away, but at a cost. Not only can the infant not get out of the high chair at such a moment; he cannot easily look away. He may feel trapped.

The bi-directional contingency process is asymmetrical

The bi-directional contingency process was asymmetrical for two of the three sets of analyses: mother into-the-face in relation to infant-initiated shared attention and in relation to infant distress. In these two sets, infant coordination with mother (mother behavior predicting infant behavior) was more likely (significant in 37.5% of possible findings) than mother coordination with infant (infant behavior predicting mother behavior) (significant in 12.5% of possible findings). In these two sets, the findings for mother behavior predicting infant behavior lasted longer over time than the findings for infant behavior predicting mother behavior.

This pattern is striking when considering the fact that, in general, the opposite obtains: Mothers are more coordinated with infants than vice versa (Beebe et al., 2016; Chow et al., 2010; Henning & Striano, 2011; Keller, Lohaus, Volker, Cappenberg, & Chastiotis, 1999; Van Egeren, Barratt, & Roach, 2001). The greater infant adjustment is seen in the more extended associations of mother into-the-face behavior predicting infant-initiated shared attention and infant distress, up to 3–4 sec. In the reciprocal equations, these two infant behaviors predict mother into-the-face behavior only in the first second.

Thus, our findings in these two sets of analyses indicate that, in this context, maternal into-the-face behavior dominates the bi-directional contingency process: Infants are adjusting to mothers more than mothers are adjusting to infants. Infants have less ability to "influence" maternal behavior. The one exception occurred in the set of equations concerning mother-into-the-face behavior in relation to infant gaze. Here, the bi-directional contingency process was more relatively balanced. Thus, despite documentation of bi-directional contingencies in each of the three patterns examined, in relation to shared attention and infant distress, maternal into-the-face behavior dominated the contingency process.

Clinical implications

Mother into-the-face behavior is often seen in dyads presenting for treatment (Beebe, 2003, 2005). Our findings suggest intervention strategies. Suggesting that mothers follow the infant's initiation of interest in a toy will generate increased shared attention, which will likely on its own decrease maternal into-the-face behaviors. Moreover, in these dyads, parents often have difficulty tolerating infant's distress. Helping the parent tolerate infant distress will also likely decrease into-the-face behavior. Sometimes, it is appropriate to directly elicit the parent's empathy for the experience of something coming into the face, which can be experienced by everyone as threatening.

Limitations/future research

The study was based on a microanalysis of 3 min of interaction per dyad, which may limit its generalizability. Nevertheless, small slices of behavior analyzed second-by-second generate highly reliable information (Ambady & Rosenthal, 1992) and yield a richness of data that is not obtained in other approaches. Our questions were limited to across-group characterizations. Because almost $\frac{1}{3}$ of the mothers did not show into-the-face behavior, future research should investigate how mothers who do versus

do not show into-the-face behavior, and their infants, may differ in other respects, such as maternal distress (depression, anxiety) or infant attachment security. Moreover, shared attention could be investigated as a protective factor in development. Although our definition of mother into-the-face behavior required movement of an object or hand into close proximity to the infant's face, future research could explore whether an object or hand in less close proximity, near the bottom of the infant's face, might be less derailing. Our measure of infant-initiated shared attention was limited to particular seconds in which the mother joined the infant's focus of attention on a toy. It did not extend to an analysis of whether the infant noticed the mother's joining. Finally, examination of the role of mother-initiated shared attention would further elucidate the bi-directional patterns of mother–infant interaction in the context of mother into-the-face behavior.

CONCLUSION

We examined a critical concept in the literature, maternal joining of infant focus of attention during play, which we termed infant-initiated shared attention. The literature documents that maternal ability to join infant attentional focus, rather than interfere with it, is optimal for infant development. Drawing on this literature, we proposed that maternal joining of infant focus of attention constitutes an important maternal behavior during play: The infant's initiative toward an object is recognized, shared, and given interpersonal significance. Despite the acknowledged importance of the mother's role in shared attention during play, there is little empirical investigation of how shared attention might unfold, the factors that might disturb it, and how both mothers and infants might contribute to this process.

Examining the temporal dynamics of the interaction, and using a microlevel coding, we documented that maternal into-the-face behavior disrupted infant-initiated shared attention, generated infant distress and altered the infant's gaze patterns. Reciprocally, infant distress and gazing away increased the likelihood of maternal into-the-face behavior. On the other hand, maternal joining of infant focus of attention inhibited maternal into-the-face behavior.

We conjecture that mother-into-the-face disturbs an aspect of the infant's experience of recognition: The initiative and agency inherent in the infant's attentional focus are over-ridden rather than recognized and shared. Additionally, it may be overwhelming to the infant. Moreover, it may disturb one process through which shared meaning is established. As such, maternal into-the-face behavior constitutes an important intrusion behavior relevant to both research and intervention. Conversely, infant-initiated shared attention may function as a powerful facilitating influence, solidifying infant experiences of recognition, and diminishing the likelihood of maternal intrusion into-the-face.

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