The effect of the Infant Behavioral Assessment and Intervention Program on mother–infant interaction after very preterm birth

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Background: Prematurity and perinatal insults lead to increased developmental vulnerability. The home-based Infant Behavioral Assessment and Intervention Program (IBAIP) was designed to improve development of preterm infants. In a multicenter randomized controlled trial the effect of IBAIP on mother–infant interaction was studied as a secondary outcome. Method: Mother–infant interaction was assessed during the Still-face procedure at 6 months corrected age. One hundred and twelve mother–infant dyads (57 intervention, 55 control) were studied. Results: Findings partially supported our hypothesis that the intervention would increase maternal sensitivity in interaction with their preterm infants. No effects were found on infant self-regulatory behavior or positive interaction behavior. Conclusion: The family-centered and strength-based approach of IBAIP appears to be a promising intervention method to promote sensitive mother–infant interaction at home after discharge from hospital. However, no positive effects were found on infant interaction behavior. Keywords: Early intervention, mother–infant interaction, prematurity, Still-face procedure.

The early mother–infant relationship is at risk when an infant is born very preterm (<32 weeks of gestation). Research on brain development has confirmed the importance of the interaction between environmental and social stimulation and neurobiological processes for the development of brain structures (Smith & Thelen, 2003; Gunnar & Quevedo, 2007; Friedman, 2006; Schore, 1994). For preterm infants, ‘normal’ environmental stimulation can cause over-arousal that may result in serious distress, which might influence brain development in a negative way (Als et al., 2004; Graham, Heim, Goodman, Miller, & Nemeroff, 1999). Postnatally, preterm infants also have more difficulties interacting with their environment, including their parents (Swartz, 2005). They initiate interaction less frequently, show less positive affect, and are less attentive (Goldberg & DiVitto, 1995; Belsky, 1984; Tronick, Scanlon, & Scanlon, 1990). They are difficult to bring into an attentive state, and once in that attentive state, they are easily over-aroused, show more negative affect and often avoid eye contact (Eckerman, Hsu, Molitor, Leung, & Goldstein, 1999).

For parents, their preterm infant's behavior may result in greater difficulty in interaction than with a term infant. Consequently, preterm infants may not be stimulated or responded to in an optimal way. Some studies have shown that parenting behavior mimics preterm infant behavior, resulting in less active and less responsive interactive behavior (Censullo, 1994). Other studies have shown the opposite, with parents being more directive, more active in initiating and maintaining interactions, and more stimulating throughout the first year (Cronin, Ragozin, Greenberg, Robinson, & Basham, 1983; Holditch-Davis, Schwartz, Black, & Scher, 2007). The repetitiveness of childcare routines and the lack of reinforcement which may accompany parenting a preterm infant can become a source of parental frustration. Mothers may become intrusive or ‘aggressive’ with their infants to compensate for perceived developmental and behavioral delays (Barnard et al., 1989; Swartz, 2005). However, a recent review of premature infant–mother interaction concluded that mothers of preterm infants do not seem to display as much intrusive or non-contingent behavior as seen in previous studies (Bozzette, 2007).

Preventive early (post-hospital discharge) interventions directed at the interaction between preterm infants and their parents to improve developmental outcome have been promoted in several studies (Spittle, Orton, Doyle, & Boyd, 2007; Bonnier, 2008). The largest effects were found on improving cognitive development in the short to medium term. In these programs special attention was also paid to the individual infant’s capacities and responses to stimulation, as well as to the individual parent’s way of handling, initiating contact and responding to their child.
Few intervention studies address the infant’s self-regulatory competence during early interactions. Self-regulatory competence is important for the infant’s social interactive and exploratory opportunities, which are necessary for learning processes (Bronson, 2000). The Infant Behavioral Assessment and Intervention Program is an intervention program that guides parents in supporting their infants’ self-regulatory competence (IBAIP; Hedlund, 1998).

In previous work, we have shown in a randomized controlled trial carried out in Amsterdam, the Netherlands, that the IBAIP enhances the mental, motor and neurobehavioral outcome of very preterm infants (<32 weeks and/or <1500 grams) at 6 and 24 months corrected age (Koldewijn et al., 2009; Koldewijn et al., 2010). In this paper we focus on the mechanisms that may have contributed to the developmental improvements in the children. The mothers in the intervention group were provided detailed information regarding their infants’ behavior and encouraged to show responsive and engaged behavior towards their infants. Therefore, the effect of the IBAIP on mother–infant interaction after the intervention period (6 months corrected age) was studied, using the Still-face procedure (Tronick, Als, Adamson, Wise, & Brazelton, 1978). The Still-face procedure consists of three short episodes: one of normal mother–infant play interaction, followed by a mildly stressful period when the mother does not interact with the infant and keeps a blank face, followed by an episode when the mother resumes playful interaction. We hypothesized that the IBAIP would: 1) improve self-regulatory competence of the infants expressed in a different pattern of behaviors across the three episodes, with better coping responses and fewer stress symptoms in the Still-face episode or more positive and explorative interaction behavior during the interaction episodes; 2) promote maternal positive and sensitive interaction behavior throughout the interaction in both the first and third episodes.

Method

Participants

Two hospitals with level III NICUs and five city hospitals participated in this trial. All infants with a gestational age of <32 weeks and/or a birth weight of <1500 grams, admitted to one of these seven hospitals and whose parents were living in Amsterdam, were eligible for the study if they survived to a post-menstrual age of 32–34 weeks. Infants with severe congenital abnormalities, infants whose mothers had a documented history of language problems (<32 weeks and/or <1500 grams) at 6 and 24 months corrected age (Koldewijn et al., 2009).

Recruitment took place from January 2004 to April 2006; 315 infants were eligible for the study. The parents of 38 infants refused participation, 11 infants died before recruitment, 38 infants were excluded and 52 participated in another post-discharge trial. Finally, 176 infants were available for randomization (151 families); 86 infants and their 72 parents were assigned to the intervention group and 90 infants and their 79 parents to the control group (for a detailed description see Koldewijn et al., 2009).

Data from 112 mother–infant dyads were available for analysis, 57 in the intervention group and 55 in the control group. Data were lost because of the absence of the mother and the presence of the father (n = 12), language problems (n = 7), infant’s age at recording (>8 months corrected age, n = 1) or too many interruptions during the procedure (n = 4). Some data could not be gathered because of parents refusing participation (n = 2), infants’ illness (n = 3), infant’s death (n = 1), no-shows (n = 3), or technical problems (i.e., recording difficulties with video or split-screen apparatus, n = 31).

Maternal sensitivity and responsiveness were analyzed in 109 mother–infant dyads, 53 in the intervention group and 56 in the control group. Data of 3 mothers could not be coded as mothers’ hands could not be seen, a specific condition for coding the MSRS.

Chi square tests and analyses of variance revealed no significant differences in neonatal and socio-demographic characteristics between the mother–infant dyads who were analyzed and those who were not. Table 1 shows the neonatal and socio-demographic backgrounds of the 112 infants and their parents in both groups. No significant differences were found between the intervention and the control group with respect to parental background and neonatal characteristics.

Intervention

The IBAIP is a post-discharge preventive intervention program for infants at developmental risk up to the developmental age of 6–8 months and their parents (Koldewijn et al., 2005; http://www.ibaip.org). It is based on the conceptual framework of Heidelise Als (1986) that underlies the Newborn Individual Developmental Care and Assessment Program (NIDCAP; Als, 1986). The goal of the IBAIP is to support the infant’s self-regulatory competence as well as the infant’s multiple developmental functions in an integrative way, via responsive and positive parent–infant interactions. Central to the IBAIP is support of the parent in raising their child. IBAIP is based on the assumption that the parent’s availability and adequate responsiveness strengthen the infant’s regulatory competence and development. Mindful attention to their infant’s behavioral expressions and development may enhance the parent–infant relationship, but also the parent’s feelings of joy, and confidence in themselves and their child.

The observational tool of the IBAIP is the Infant Behavioral Assessment (IBA; Hedlund & Tatarka, 1988). The IBA helps the interventionist to sensitise
parents to their baby’s responses to sensory information in order to assist parents in supporting their infant’s self-regulatory efforts and to adjust the environment to match the neurobehavioral needs of the infant. For instance, the interventionist may encourage the parent to co-regulate by supporting the infant’s efforts to still his or her movements when the infant shows interest in an object in the environment. Or the interventionist may help the parent to interpret the infant’s behavioral expressions of environmental overload (e.g., blinking the eyes, looking away from the object, and retraction of the shoulders), and give suggestions for environmental adaptations which may help the infant to regain neurobehavioral balance.

As the infant matures and his or her neurobehavioral functioning becomes increasingly stabilized, parents are encouraged to gradually reduce their co-regulatory support and to enjoy their infants’ growing independence.

The infants in the intervention group received 6–8 home visits by the interventionists, experienced pediatric physical therapists trained in the IBAIP. To a certain extent, the frequency was tailored to the needs of the family, hence the number of visits varied from 6 to 8; two families had 6 interventions, two had 7, all others had 8. After each intervention session (approximately one hour) the parents received a report, illustrated with pictures of their infant. This report described the infant’s neurobehavioral and developmental progress and gave suggestions on how to support the infant’s explorations and self-regulatory competence.

The infants in the intervention group also received standard care, which consisted of regular visits to the outpatient local pediatric clinic. The infants in the control group received only standard care.

### Table 1 Neonatal and socio-demographic characteristics of intervention and control group

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Intervention (n = 57)</th>
<th>Control (n = 55)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestation (wk), mean (SD), range</td>
<td>29.5 (2.1) (26–35)</td>
<td>30.1 (1.9) (25–35)</td>
<td>.08</td>
</tr>
<tr>
<td>Birth Weight (g), mean (SD), range</td>
<td>1246 (356) (640–2005)</td>
<td>1328 (335) (495–2095)</td>
<td>.21</td>
</tr>
<tr>
<td>Gender infant: male/female</td>
<td>33/24</td>
<td>25/30</td>
<td>.19</td>
</tr>
<tr>
<td>Multiplets, n (%)</td>
<td>20 (35%)</td>
<td>23 (42%)</td>
<td>.09</td>
</tr>
<tr>
<td>Artificial ventricle n (%)</td>
<td>25 (45%)</td>
<td>19 (35%)</td>
<td>.31</td>
</tr>
<tr>
<td>Intraventricular hemorrhage (IVH) n (%)</td>
<td>11 (22%)</td>
<td>8 (14%)</td>
<td>.35</td>
</tr>
<tr>
<td>IVH grade I +II /III + IV</td>
<td>8 / 3</td>
<td>7 / 1</td>
<td>.43</td>
</tr>
<tr>
<td>Periventricular leukomalacia (PVL) n (%)</td>
<td>8 (15%)</td>
<td>6 (11%)</td>
<td>.54</td>
</tr>
<tr>
<td>PVL grade 1 / 2+3</td>
<td>7 / 1</td>
<td>5 / 1</td>
<td>.82</td>
</tr>
<tr>
<td>Maternal age, mean (SD), y</td>
<td>32.7 (5.3)</td>
<td>31.6 (5.2)</td>
<td>.25</td>
</tr>
<tr>
<td>Paternal age, mean (SD), y</td>
<td>36.7 (7.7)</td>
<td>35.8 (6.1)</td>
<td>.50</td>
</tr>
<tr>
<td>Firstborn child (%)</td>
<td>35 (64%)</td>
<td>27 (52%)</td>
<td>.22</td>
</tr>
<tr>
<td>Country of birth, mother (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>33 (58%)</td>
<td>31 (57%)</td>
<td></td>
</tr>
<tr>
<td>Surinam</td>
<td>10 (18%)</td>
<td>6 (11%)</td>
<td></td>
</tr>
<tr>
<td>Morocco</td>
<td>10 (17%)</td>
<td>15 (25%)</td>
<td>.33</td>
</tr>
<tr>
<td>Other</td>
<td>10 (17%)</td>
<td>3 (7%)</td>
<td></td>
</tr>
<tr>
<td>Mother speaking Dutch</td>
<td>51 (89%)</td>
<td>42 (78%)</td>
<td>.09</td>
</tr>
<tr>
<td>Maternal education (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not high school graduate</td>
<td>20 (35%)</td>
<td>20 (36%)</td>
<td></td>
</tr>
<tr>
<td>High school graduate</td>
<td>37 (65%)</td>
<td>34 (63%)</td>
<td>.83</td>
</tr>
</tbody>
</table>

Analyses of variance and Chi-square test.

Note: Numbers are given as number of infants unless otherwise stated.

* at least 2 infants survived.

II Intraventricular haemorrhage (IVH) was defined according to Papile, Munsick-Bruno, and Schaefer (1983); periventricular leukomalacia (PVL) according to de Vries, Eken, and Dubowitz (1992).

### Instruments

The Still-face procedure follows a systematic protocol to observe parent–infant interaction and code it with the Infant and Caregiver Engagement Phases (ICEP; Weinberg & Tronick, 1999) and the Maternal Sensitivity and Responsivity Scales (MSRS; Cenciotti, Tronick, & Reck, 2004). The Still-face procedure is mainly used for research purposes and different coding systems have been used (Mesman, Van IJzendoorn, & Bakermans-Kranenburg, 2009). It can also be used in a clinical setting as a standardized setting in which to observe the interaction between mothers (or others) and their infants and to assess the appearance of the ‘Still-face effect’ and handling of the slight distress involved.

The Still-face procedure confronts the infant with an age-appropriate developmental task (face-to-face social interaction with the mother), an age-appropriate episode of mild stress (the mother maintaining a still-face and remaining unresponsive), and a reunion episode during which the infant and mother renegotiate the interaction after it has been disrupted by the still-face (reunion face-to-face interaction with the mother) (Tronick, 2007). The mother sits in front of the infant at eye level and the infant is in an infant seat. The procedure starts with the face-to-face social interaction episode of 2 minutes in which the parent is instructed to interact with the infant. The parent can touch and talk to the infant, but cannot use any toys in the interaction, except for objects inherent to the face-to-face setting. After these 2 minutes the parent turns around, presenting her/his back to the infant for 15 seconds. Then the parent turns back and the Still-face episode begins. The parent is not allowed to make any contact whatsoever and is instructed to look at the side of the infant.
The duration data resulted in a total percentage of time that the infant or caregiver was engaged in a behavior. The percentages for each behavior were computed for the separate episodes (normal play, still-face, reunion).

The MSRS were used to capture the attunement of the mother to the infant during interaction. The MSRS consist of three rating scales, the sensitivity/responsivity scale, the undercontrol/withdrawal scale, and the overcontrol/intrusivity scale. Sensitive and responsive maternal behavior is defined as consistent, contingent and appropriate reactions to the infant’s behavior. Undercontrolling and withdrawal behavior is characterized by disengagement and lack of investment in the interaction, which often makes the interaction seem flat and boring. Overcontrolling and intrusive behavior is characterized by over-stimulation, interruption, and non-contingent behavior. Overcontrolling mothers impose their own behavior without looking at the infant’s reaction and behavior. The scales range from 1 for no visible signs of the behavior to 5 for consistent and strong signs of the behavior (e.g., persistent and strong overcontrol). The MSRS were coded by a trained coder (DM) from DVD. Pearson’s correlation coefficients for interrater reliability were .77 for sensitivity, .90 for undercontrol and .70 for overcontrol after training.

Procedure

At the (corrected) age of 6 months the infants and their parents were invited to come to the hospital for an extensive assessment consisting of physical examination, IBA and Bayley Scales of Infant Development assessment and the Still-face procedure. If parents were unable to come to the hospital, they were visited at home, which was done in 21 (37%) intervention and 16 (29%) control cases, a nonsignificant difference. After a short introductory conversation, the Still-face procedure was carried out.

All assessors, including the standard care providers, were blind to the infant’s group assignment. In this single blind randomized controlled trial only parents and interventionists were aware of group assignment. Parents were instructed not to inform the outcome-assessors.

The Medical Ethics Committee of all hospitals involved in this trial approved the study. This trial is registered with controlled-trials.com, number ISRCTN65502576. All participating parents signed informed consent.

Statistical analyses

Characteristics of the intervention and control group were compared with analyses of variance or Chi square tests. The data on the Still-face procedure were studied in two ways. First, analyses of variance for repeated measures were performed to analyze group differences in interaction behavior (ICEP) across the three episodes (Play, SF, Reunion). Group (intervention, control), infant gender (male, female) and place of recording (home, hospital) were used as fixed factors. Gender was chosen as a factor because preterm boys have frequently been reported to show increased vulnerability and gender differences have been found during the Still-face procedure with full term infants (Weinberg,
Tronick, Cohn, & Olson, 1998; Belsky, 1984; Tronick & Cohn, 1989). Place of recording might be important as recording in the strange hospital situation might be more stressful than at home.

Second, differences per episode of the Still-face procedure were studied with both multivariate and univariate analyses of variance, again with group, gender and place of recording as factors, as group differences could appear more clearly in one of the episodes or in one specific behavior.

Differences in the assessment of maternal interaction quality (MSRS) were studied with multivariate as well as univariate analyses of variance, as group differences could appear in the overall assessment, as well as only in specific aspects of behavior. Again group, gender and place of recording were used as factors.

Mother–infant interactions in mothers of twins were coded independently (one with each child). Assuming that mother–infant interaction is a process of mutual regulation, every mother–infant pair should be treated as independent. Twins were included in the same group and the number of twins did not differ between the intervention and control group.

All statistical analyses were performed using version 14.0 of the Statistical Package for Social Sciences (SPSS 14.0, Chicago, IL, USA). An alpha level of .05 was used for tests of significance.

Results

Infant interaction behavior

The means and standard deviations of the percentage of time of the infants’ interaction behavior are presented in Table 2. Distancing behavior or sleep was not observed and was not analyzed. The results of the analysis for repeated measures are reported for group, gender, place of recording, episodes and the group-by-episode interaction in Table 2 as well.

For positive engagement a main effect for group (p = .04) was found, as well as an effect of episodes (p < .01) and an interaction effect for group by episodes (p = .04). The infants in the intervention group showed less positive engagement (smiling), especially during the first episode. For environment-focused behavior a group by episodes interaction effect (p = .02) was found. Infants in the intervention group showed more environment-focused behavior during the first episode (normal play) than the control group. No other between-group differences or group-by-episode effects were found. Our hypothesis that the infants in the intervention group would show more positive and exploratory behavior during the interaction episodes of the Still-face procedure was not confirmed.

No main effect for gender was found in these repeated measures analyses. Place of recording showed a significant main effect for both mother-focused behavior (F(1,96) = 8.45, p < .01) and environment-focused behavior (F(1,96) = 5.08, p = .03). In the hospital the infants showed more mother-focused behavior and less environment-focused behavior than in the home situation.

The Still-face effect is seen for both groups in the significant impact of episode on positive engagement, environment-focused behavior, negative behavior and self-clasp behavior. The children showed less positive engagement and more environment focus and self-clasp behavior during the Still-face episode, and more negative behavior in the reunion episode. No differences were found in self-regulatory behavior or stress reactions of the infants throughout the procedure or in specific episodes related to group, hence our hypothesis was not confirmed.

Multivariate analyses on the first episode showed an interaction effect for group-by-place of recording (F(7,98) = 2.22, p = .04). The infants in the intervention group focused less on the environment (F(1,104) = 5.65, p = .02) and showed more positive behavior (smiling) (F(1,104) = 12.00, p < .01) during the hospital recordings than the control infants.

Table 2 Infant interaction behavior in % of time

<table>
<thead>
<tr>
<th>Infants N = 112</th>
<th>Normal play</th>
<th>Still-face</th>
<th>Reunion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Behaviors</td>
<td>Intervention</td>
<td>Control</td>
<td>Intervention</td>
</tr>
<tr>
<td>Positive, smiles</td>
<td>4.7 (6.3)</td>
<td>8.1 (14.0)**</td>
<td>1.1 (2.4)</td>
</tr>
<tr>
<td>Mother focused</td>
<td>24.4 (16.8)</td>
<td>25.2 (14.6)</td>
<td>22.2 (17.0)</td>
</tr>
<tr>
<td>Environment focused</td>
<td>66.5 (23.0)</td>
<td>63.4 (20.5)*</td>
<td>71.5 (21.7)</td>
</tr>
<tr>
<td>Negative</td>
<td>2.8 (9.1)</td>
<td>1.6 (5.2)</td>
<td>4.7 (15.2)</td>
</tr>
<tr>
<td>Stress</td>
<td>0 .02 (1.14)*</td>
<td>.2 (1.2)</td>
<td>.3 (1.5)</td>
</tr>
<tr>
<td>Oral S-Ct²</td>
<td>5.4 (13.0)</td>
<td>5.6 (10.5)</td>
<td>9.8 (14.9)</td>
</tr>
<tr>
<td>Self-clasp</td>
<td>2.3 (4.7)</td>
<td>1.2 (3.0)*</td>
<td>2.5 (6.6)</td>
</tr>
</tbody>
</table>

Note: Analyses of variance for repeated measures (corrected for infants gender and place of recording).
1Group: intervention or control (intervention effect); ²Oral self-comforting: hand or finger touches mouth.
*p ≤ .05, **p ≤ .01.

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A main effect was found for gender ($F(7, 98) = 2.59$, $p < .01$) and place of recording ($F(7, 98) = 2.40$, $p = .03$), boys were less environment focused than girls ($F(1, 104) = 11.34$, $p < .01$) and the infants recorded at the hospital were more focused on their mothers than those at home ($F(1, 104) = 9.35$, $p < .01$).

For the Still-face episode the MANOVA showed that place of recording differed ($F(7, 94) = 2.91$, $p < .01$). Children recorded at the hospital focused less on the environment ($F(1, 104) = 6.28$, $p = .014$) and showed more oral self-comforting ($F(1, 104) = 5.38$, $p = .02$).

For the reunion episode the MANOVA showed no significant effects.

### Maternal interaction behavior

Exaggerated positive engagement, rough touches and violations of the procedure were not observed. The mothers mostly showed neutral (62%) and positive social monitoring behavior (27%) and little negative behavior (0.8%). Table 3 presents the means and standard deviations of the percentage of time that the mothers showed the coded behaviors in the first play episode and in the last reunion episode. The results of the analysis for repeated measures are reported for group, episodes and the group-by-episode interaction in Table 3 as well.

An effect of episodes was found for neutral social monitoring behavior; mothers showed more neutral social monitoring behavior in the reunion episode. No main effects for group, gender and place of recording were found.

In the first play episode univariate analyses showed more positive behavior in the mothers in the intervention group ($F(1, 100) = 3.92$, $p = .05$). Multivariate analyses, however, indicated no main or interaction effects in overall group, gender or place of recording in maternal behavior during the first play episode, nor during the reunion episode. Our hypothesis concerning more positive engaged interaction behavior of the mothers in the intervention group was not confirmed.

### Maternal sensitivity and responsivity

In Table 4 the results for the rating of maternal sensitivity and responsivity throughout the Still-face procedure are presented. Multivariate analyses of variance showed an interaction effect for group by gender ($F(3, 98) = 2.71$, $p = .05$), but none for the univariate comparisons of group by gender differed significantly. No other main or interaction effects were found on group, gender or place of recording. Univariate comparisons indicated that mothers in the intervention group showed more sensitivity and used less overcontrolling behaviors than the mothers in the control group (Table 4). This finding confirms our hypothesis.

### Discussion

The comparison of the intervention group and control group during interaction in the Still-face procedure showed a few subtle differences. The rating of the mothers’ attunement in the intervention group was somewhat more sensitive and less intrusive than in the control group, hence our hypothesis regarding maternal behavior was partially confirmed.

The micro-analytic observation showed only a small difference in positive engagement behavior of the mothers. In contradiction to our hypothesis, the infants in the intervention group were found to show less positive behavior than the control infants and they focused more on the environment, specifically during the first play episode. These behaviors may be related. During exploration of their environment, smiling is less expected than in interaction with the mother. Interestingly, an interaction effect of group by place of recording was also found concerning positive behavior and exploration of the environment. During the recording in the potentially more stressful hospital environment, the intervention infants smiled more and explored less than the control infants, whereas this was reversed in the recordings made at home. In both groups the children focused more on their mothers during the

### Table 3 Maternal interaction behavior in % of time

<table>
<thead>
<tr>
<th>Mothers $N = 112$</th>
<th>Normal play</th>
<th>Reunion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td></td>
<td>Intervention</td>
<td>Control</td>
</tr>
<tr>
<td>Negative</td>
<td>.1 (.67)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Non-infant focused</td>
<td>.2 (.73)</td>
<td>.2 (.69)</td>
</tr>
<tr>
<td>Social monitor/nvc</td>
<td>58.2 (20.1)</td>
<td>54.9 (23.7)</td>
</tr>
<tr>
<td>Social monitor/pvc</td>
<td>24.5 (20.4)</td>
<td>28.6 (24.6)</td>
</tr>
<tr>
<td>Social positive engagement</td>
<td>3.9 (4.0)</td>
<td>2.5 (3.0)*</td>
</tr>
</tbody>
</table>

Note: Analyses of variance for repeated measures (corrected for infants gender and place of recording).

nvc = no/neutral vocalizations, pvc = positive vocalizations.

*p ≤ .05, **p ≤ .01.

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hospital recordings. Perhaps this shows context-dependent functioning.

The findings also suggest an alternative explanation for the decrease in smiling in the intervention group. At about 6 months of age term infants become increasingly interested in their environment (Legerstee, Pomerleau, Malcuit, & Feider, 1987) and in objects (Cohn & Tronick, 1987). Thus it might be that the intervention infants showed improved development in this behavioral pattern; that is, the increase in maternal sensitivity of the intervention mothers fostered a normal developmental transition from a focus on the mother to a focus on objects. This observation also supports the previous finding that the infants receiving intervention compared to the non-intervention infants at 6 months of age were more advanced on the Bayley Scales of Infant Development (Koldewijn et al., 2009).

The hypothesis that the intervention group infants would show better regulatory behavior, for instance an easier repair of interaction during the reunion episode or fewer stress responses throughout the Still-face procedure or in specifically stressful episodes, was not confirmed. However, the ICEP does not allow a measurement of self-regulatory behavior in great detail. For instance, a distinction in infant’s gaze aversion as either self-regulatory behavior following emotional arousal, or as real object- or environment-focused behavior, could not be coded. Further study should be done to observe infants’ self-regulatory behaviors more closely.

Along with the studies by Segal et al. (1995), Montiroso, Borgatti, Trojan, Zanini, and Tronick (2008), Hsu and Jeng (2008) and Erickson and Lowe (2008), this is one of the few studies to demonstrate the sensitivity of preterm infants to the Still-face procedure. Hsu and Jeng (2008) compared Taiwanese 2-month-old preterm (gestation range 24–34 weeks) and term infants during the Still-face procedure and found longer duration of negative affect in preterm infants and shorter latency to negative states. In a sample of very low birth weight infants it was found that maternal responsiveness was strongly associated with the amount of positive infant affect, but not with negative infant affect (Erickson & Lowe, 2008). Erickson and Lowe (2008) suggested a relative chronicity or maintenance of negative affect and proposed that early relationship-focused intervention might increase parental responsiveness. A recent review of the Still-face paradigm showed that maternal interaction behavior is not necessarily associated with infant interaction behavior during the three episodes (Mesman et al., 2009). This fits our results: in the intervention group the mothers showed more sensitive and positive interactive behavior, but the infants did not show more positive interaction behavior in the intervention group.

**Strengths and limitations**

A strength of our study is that it was a randomized control trial; however, a pretest–posttest design might more readily have found a significant improvement in interactive behavior. A design with a dummy-treated control group that controlled for potential attention effects of the intervention would have also been useful. Consequently, we cannot determine which part of the intervention procedure (only attention, or the actual information and support provided) is responsible for any of the results. Another potential limitation of the study is that it was done in a sample of mothers of preterm infants without a history of drug use or mental health problems, which limits the generalizability of the results to that population.

Usually the Still-face procedure is used in a laboratory setting, which was not feasible for us. The hospital setting reflected the laboratory setting better than the home setting, so we controlled for setting. In view of our results regarding smiling and exploration of the environment, this warrants further study on setting of the Still-face procedure. The use of the Still-face procedure allowed observation of mother–infant interaction in a relatively standardized way over a short period of time. A limitation of the use of the Still-face procedure, however, is that it does not reflect a natural interaction between infant and parent. Mothers may experience the Still-face procedure as somewhat stressful and discomforting for their child (Mayes, Carter, Egger, & Pajer, 1991). It may change their behavior during the reunion episode, when they are reacting to the stress and changes in behavior of the infant as well as to their own reaction to the Still-face procedure. Mothers in the intervention group, however, may have become better able to deal with a special situation like this, because they received information on how to respond to the behavioral cues of their infant by adjusting the environment and offering co-regulatory support.

### Table 4 Maternal Sensitivity and Responsivity Scales (MSRS)

<table>
<thead>
<tr>
<th></th>
<th>Intervention group</th>
<th>Control group</th>
<th>F</th>
<th>DF</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>4.13 (.78)</td>
<td>3.91 (.84)</td>
<td>3.80</td>
<td>1, 108</td>
<td>.05</td>
</tr>
<tr>
<td>Overcontrol/Intrusiveness</td>
<td>1.75 (.87)</td>
<td>2.04 (.93)</td>
<td>4.29</td>
<td>1, 108</td>
<td>.04</td>
</tr>
<tr>
<td>Undercontrol/Withdrawn</td>
<td>1.32 (.55)</td>
<td>1.38 (.68)</td>
<td>.30</td>
<td>1, 108</td>
<td>.58</td>
</tr>
</tbody>
</table>

*Note: Analyses of variance (corrected for infants gender and place of recording).*
The findings in this study were limited. Nevertheless, we think they provide important information on maternal sensitivity and exploratory behavior of the infants and the effect of the IBAIP. Although IBAIP may not have led to robust changes in mother–infant interaction, the information on our subtle findings is important in view of the developmental improvement of the intervention infants. Indeed, given the huge number of moment-by-moment interchanges between infants and their mothers, even small and subtle changes can accumulate and lead to large developmental differences. Further study on the effect of IBAIP on mother–infant interaction should be done to evaluate what part of the intervention procedure may affect improvements in maternal sensitivity that may contribute to the development-enhancing effect of IBAIP for preterm infants. Currently, further study on the relationship between our findings regarding mother–infant interaction and infants’ developmental outcome is being carried out.

Key points

- Prematurity leads to increased developmental vulnerability. Preventive early (post-hospital discharge) interventions to improve developmental outcome have been promoted in several studies.
- The IBAIP assists parents in supporting their infant’s self-regulatory efforts and adjusting the environment to match the neurobehavioral needs of the infant in order to enhance development and satisfactory parent–infant interaction.
- This RCT showed that the IBAIP enhances maternal sensitive interaction behavior with their very preterm infant.

References


Erickson, S.J., & Lowe, J.R. (2008). The role of maternal responsiveness in predicting infant affect during the Still


Noldus. The Observer [program]. Wageningen, The Netherlands.


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