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CHAPTER 9

MATERNAL UNRESPONSIVENESS AND INFANT CRYING. A CRITICAL REPLICATION OF THE BELL & AINSWORTH STUDY

Frans O.A. Hubbard and Marinus H. van IJzendoorn

ABSTRACT

The present study reports an effort to make a critical replication of the longitudinal naturalistic Bell & Ainsworth study (1972).

Twenty-five infant-mother pairs were observed in their homes at three-weeks intervals during the first nine months. This report focuses on the main conclusion of Bell & Ainsworth (1972) that mothers who responded more consistently and promptly to their infant's crying in earlier quarters had infants who cried less frequently and for shorter periods of time in subsequent quarters. The evidence of this study suggests that regarding the durational measures this conclusion is based on "spurious correlations", control of likely antecedent and concurrent determinants of infant crying yielded partial correlation patterns contradicting the Bell & Ainsworth conclusion. These striking findings are discussed in an evolutionary context with reference to the balanced view that crying behavior is not an on/off signal but a *graded signal*. Consequently, *differential responsiveness* seems to be more adequate.

INTRODUCTION

Infant crying implies many young parents' first confrontation with the drawbacks of child-rearing. Some types of loud and prolonged crying provoke physiological reactions comparable to

reactions in situations in which one is continually insulted, treated condescending or even receiving electric shocks (Frodi, 1985a, p.360). No wonder that excessive crying has been identified as one of the main causes of child abuse and neglect (Frodi, 1985b). Therefore, it is necessary to prevent or combat excessive crying through effective interventions by the caregivers. The question is which parental behavior may be regarded as effective. If crying is only regarded as a nuisance, and merely viewed as an abject but meaningless vocalization, an obvious solution is to try to decrease its frequency and intensity by neglecting it. If, however, some reason or function is attributed to crying, it is self-evident to take its signal value seriously, and consequently to try to remove the cause or reason, or to react some other way to the signal.

Attachment theory and crying behavior

From the perspective of attachment theory, crying is attributed the function of maintaining the baby's proximity to protective adults. The so-called expressive crying in the first few months has the function - and not the intention - of informing the environment about the needs of the organism, for example the need for food, or company, or removal of the source of pain. Expressive crying does not contain intentional signal value, but rather the environment regards it as a meaningful signal. Bowlby (1971) supposes that crying belongs to the class of pre-attachment behaviors, such as sucking and smiling, that served the human species in its evolutionary struggle for life. This type of behavior unintentionally stimulates proximity to the caregiver and originally served as protection against attacks from predators, etc. In the cybernetic model of attachment theory it is plausible to consider crying to be terminable by a quick response from the caregiver, instead of being reinforced. If crying is seen as directed towards the goal of proximity to the caregiver, reaching that goal should be enough "reason" to end the crying behavior. It is supposed that much crying due to a seemingly physical cause should ultimately be considered as socially oriented. Expressive crying, too, is supposed as having a communicative function.

For that matter, mothers often think that infant crying in the first few weeks and months after birth can effectively be combatted by changing diapers. Wolff (1969) did research in which he asked caregivers to change diapers of nine babies six times. In half of the cases he asked the caregivers not to give the baby a new and dry diaper, but to replace the wet one. Babies without a new diaper appeared to stop crying after

the diapering ritual as fast as babies with a dry and clean diaper. Wolff had made sure the babies' temperature at the same level in both groups: a decrease of temperature caused by a wet diaper would stimulate crying behavior (Wolff, 1969, p.88). This "simple" study appears to indicate that the baby is crying to make contact with the caregiver, and that crying behavior is terminated if the set-goal of 'proximity' is realized. In his crying studies, Wolff (1969) also showed that rocking the baby in a rhythm of 80-140 moves per minutes was effective in terminating crying behavior. Bowlby took this result as a confirmation of his idea that crying is rooted in evolution. He supposes that the baby at least needs the rhythm of a slow walk to feel itself safe and consequently to stop crying, and he refers to the way in which babies were probably carried around by their mothers in the environment of evolutionary adaptedness (see also Murray, 1979).

This interpretation of crying did not incline Bowlby to propagate a prompt response to every kind of crying behavior. For the very reason that crying does have signal value, the perception of intensity, temporal structure and context has to determine the attribution of meaning to the behavior. Dependent upon the information the crying behavior is carrying, caregivers could respond promptly or slowly: "As a rule, crying leads a mother to take steps to arrest it; this she does either instantly, as when she hears a sudden pain cry, or in her own time, as when rhythmic crying builds up gradually" (Bowlby, 1971, p.347). From this quotation it may be understood that Bowlby does not consider crying as an on/off signal to which the same meaning should be attributed in all cases, and to which one would have to always respond in the same prompt way. For him crying is a graded signal (Murray, 1979) with a range of possible interpretations.

The idea of crying as a graded signal leads to the question whether merely on acoustical grounds the right meaning can be attributed to different types of crying behavior. There has been some experimental research done on the signal value of different types of crying, such as the pain and hunger cry. The research group of Wasz-Höckert, Partanen, Vuorenkoski, Vallanné, and Michelsson (1964b;1968) did produce empirical evidence in favor of the thesis that it would be possible to discriminate different cry-types merely on acoustical grounds. This research has been sharply criticized methodologically (Muller, Hollien & Murry, 1974) but a replication study of Brennan and Kirkland (1979), who bore the criticism in mind had the result that musically trained observers were capable of discriminating different types of crying vocalizations. From the studies of Gladding (1978;1979;1980) it was derived that training and experience with children influence compe-

tence in distinguishing crying vocalizations. Sagi (1983), too, demonstrated that having children stimulates competence in distinguishing between different cry signals, and that generally having experience with children leads to better cry discrimination. Sagi (1983) speculated about the existence of a predisposition which would naturally attune the mother to her own baby (referring here to the Bell & Ainsworth, 1972 study we will discuss below). Be that as it may, the research literature shows that training the discriminatory competence is an effective means for learning to identify different cry vocalizations in an experimental setting.

More important than experimental research for understanding crying in natural settings are the studies done by Wolff (1969; 1976). He, for example, did an experiment in the home setting regarding the relation between type of crying and maternal response. While the mother was present in an adjacent room, Wolff played a certain cry type on audiotape and measured the latency of response. Furthermore, verbal reactions of the mother were registered. Almost every mother appeared to respond very promptly and anxiously to a pain cry. The mothers reacted quicker to a mad or angry cry than to a hunger cry in order to check the baby's well-being without really being alarmed. The mothers were more or less amused by the anger of their baby. Mothers did not react in a fixed pattern to the hunger cry; consequently, Wolff suggested a correspondence with the global caregiving style of the mother. If the long expiration phase was deleted from the pain cry, mothers appeared to be less anxious than in case of a real pain cry. The cry of a baby after repeatedly offering and taking away a pacifier seemed to be similar to the pain cry. The difference, however, is the absence of a long expiration phase. Mothers did react to this kind of crying less anxiously but with the same promptness as in case of a pain cry, from which the long expiration phase is deleted.

From research regarding the signal value of crying it can thus be derived that different cry types lead to different interpretations and reactions. Crying is not an on/off signal intensity, temporal structure (e.g., length of expiration phase) and context give every cry its specific meaning. For almost every caregiver a long and ominous expiration phase appears to be reason enough to respond spontaneously and promptly, but a more gradual building up of the cry pattern gives more room for adopting a wait-and-see attitude.

If crying has an evolutionary based function, it is plausible that certain cry types do have some definite signal value, and represent compelling "calls" for proximity and security (Murray, 1979). Intense crying with or without a long expiration phase may possibly have such a function. In that

case, the only response of the caregiver should be to seek the baby's proximity, in search for the cause of its distress. Other types of crying vocalizations would have much less unequivocal connections to a certain kind of distress, and therefore leave room to much more diffuse responses from the caregiver. This kind of crying may have much less of a releaser function (Murray, 1979) as compared to the intense cry, and its evolutionary bias would be much less obvious. For the survival of the species, fussing would have a somewhat different function as long and loud, anxious crying. Against this background, Bowlby's comment is understandable that to "A cry that starts at low intensity ... (the mother's) response is likely to be more leisurely" (Bowlby, 1971, p.298).

Bell and Ainsworth's radical theory of crying

A radical interpretation in the seventies was substituted for the balanced view of the "founding father" of attachment theory on the function of crying and its adequate response. Bell and Ainsworth's (1972) study on "Infant crying and maternal responsiveness" raised a good deal of dust, not only because of the data but also because of its polemical style. The researchers did not confine themselves to a cool presentation of data from the perspective of attachment theory, but initiated a discussion with conditioning theory. Their intention was to place doubt as to the validity of the latter in explaining the development of crying behavior. Without relating this discussion here, we would like to describe the Bell and Ainsworth study somewhat more extensively, because it has served as a model for the critical replication study to be reported afterwards.

We have spoken about the radicalization of attachment theoretical ideas on crying because the global conclusion of the study was that consistently and promptly responding to almost all forms of crying would result in a decrease of crying during the baby's first year. This conclusion was embedded in a general view on the relationship between maternal responsiveness and development of the child's competence. Responsive reactions to crying would lead to refinement and enlargement of the child's communicative competence, replacing disturbing forms such as crying and fussing. It was also suggested that responsive reaction to crying would stimulate the development of trust and self-reliance. The infant would derive a feeling of competence and mastery over the environment from the perception of a prompt reaction to its crying. If the child really feels in danger it anticipates short latencies in the caregiver's response. In mild distress it does not feel urged to alarm the environment directly by

crying. During the last months of the first year crying behavior would only be activated by extreme anxiety and distress.

By embedding the relationship between responsiveness and crying behavior in a fundamental view on the complex relationships between parental reaction and child's competence, research on crying evolved into a "pièce de résistance" of attachment theory. Besides the undifferentiated view on crying, which was considered as attachment behavior in almost all forms, this embedding contributed to a radicalization of thinking about crying and responsiveness. It constituted a cornerstone of attachment theory and therefore was not really open to theoretical and empirical criticism. Especially because of the practical relevance of the cry study, it would have been better if the discussion had been radicalized less quickly, and if more time had been spent on carefully testing the hypothesis. In reacting to the devastating criticism of Gewirtz and Boyd (1977), Bell and Ainsworth felt obliged to stress the explorative nature of their Baltimore study and to underline the need of replications (Ainsworth & Bell, 1977).

The design of the study and the data analysis indeed show the explorative character of the project. The study was done on a middle class Baltimore sample. 26 mother-infant dyads were visited at home for about four hours per three weeks, during the whole first year after the birth of the baby. Observers took notes while observing unobtrusively the mother-infant interactions, which were later written out as a narrative account. Time intervals of five minutes were marked off in the accounts, but time-markers were included irregularly by the observers (Lamb, Thompson, Gardner, & Charnov, 1985, p.60); therefore the duration of activities and events sometimes had to be estimated afterwards. Because of the semiparticipant role of the observer and the paper-and-pencil method of registration, duration and frequency of crying could not always be measured very precisely. The narrative accounts contained reports on interactions, evaluations of observers, and comments of the mother on her infant. At the end of the first year the dyads were observed in the Strange Situation procedure. The narrative accounts were coded afterwards on several scales and measures, and intercoder agreements were established. In the narrative accounts, every cry-event during the home visit was coded. In particular the following variables were measured: duration of crying, whether mother responded to the crying, and if so, how long she waited before reacting. The main question Bell and Ainsworth (1972) posed concerned the relationship between maternal responsiveness and frequency and duration of crying during the baby's first year. The direction of the influence would also have to be unraveled. The measures for crying behavior contained fussing as

well as crying, and very short crying as well as long and intense crying. Bell and Ainsworth constructed two measures: a) Frequency of crying episodes per waking hour; b) Total duration of crying in minutes per waking hour. Two important measures for maternal responsiveness were constructed: 1) The number of crying episodes ignored by the mother; 2) Duration of maternal unresponsiveness, e.g., number of minutes per waking hour during which the baby cried without or before a maternal intervention.

Results of the longitudinal study seemed to be unequivocal. First, crying in the first half year appeared to be much less stable than maternal responsiveness. This would exclude a purely constitutional explanation (e.g., irritability) for the differences in crying behavior at the end of the first year. Secondly, correlations between crying measures and measures for maternal unresponsiveness were computed. After correction for confounding of these measures in computing correlations for the same quarter (a correction which was criticized afterwards by the authors; see Ainsworth & Bell, 1977), the relationship within the first two quarters seemed to be less strong than in the last two quarters. Except in the first months, there was a tendency of more and longer crying by infants whose mothers were less responsive. The same seemed to hold true for the correlations across the quarters. Less responsive reactions to crying in the first quarter correspond with more frequent crying in a later quarter. The reverse seemed not to be true, namely that much crying in an earlier period corresponded with less responsiveness later. However, this reversed relationship appeared to be true in the second half year, reason for Bell and Ainsworth to warn against a vicious circle; if mothers are less responsive in the first quarters, longer and more frequent crying is the consequence, which, in its turn, leads to less responsive behavior in the last two quarters. All reported correlations were non-parametric.

The study thus seemed to have produced clear-cut results, which therefore played an important role in scientific as well as in practical discussions. However, the study has also been criticized very sharply. The most important criticisms came from Gewirtz and Boyd (1977) and Lamb et al. (1985). Gewirtz and Boyd made the following points amongst others: 1) Mother and infant variables are principally confounded. A mother cannot be responsive nor unresponsive if the child does not cry. The correction of Bell and Ainsworth cannot be a solution to this problem. 2) In computing the correlations across quarters, important concurrent and antecedent variables were not controlled. (It would have been important, for example, to control for unresponsiveness in the same quarter and infant

crying in an earlier quarter in computing the correlation between crying in a later and responsiveness in an earlier quarter).¹ Through the use of non-parametric methods partializing was impossible, but the quality of the data would permit use of parametric correlation coefficients. 3) The measurement of central variables was not precise enough to state conclusions about the absence of operant conditioning. The latter criticism of inexact measurements was also brought forward by Lamb et al. (1985). They remarked that the data collection procedure of narrative accounts, to which rating scales and frequency measures were applied afterwards, cannot exclude the possibility of the narrative accounts containing much error variance. No exact information on the reliability of these accounts is available. In addition, time-markers were not consistently used. Therefore, Lamb et al. concluded that replication would be necessary to confirm the generated hypotheses. In fact, this conclusion corresponds to the opinion of Ainsworth and Bell (1977) themselves in their polemic discussion with Gewirtz and Boyd: "We hold that the only satisfactory answer to the substance of the criticism that Gewirtz and Boyd raise is replication of findings with another sample" (p.1211). The question is whether such a replication has already been realized since the publication of the original study some fifteen years ago.

Replication of the Baltimore study on crying

The most important studies in which at least a partial replication of the Baltimore cry study was conducted, were reported by Belsky, Rovine and Taylor (1984), Grossmann, Grossmann, Spangler, Suess and Unzner (1985), Crockenberg and Smith (1982), and Landau (1982). The first two studies were carried out in the U.S.A., the third study was done in Bielefeld (West-Germany), and the last study in Israel. All the studies contained hypotheses in addition to the question of the relationship between crying and responsiveness, but we will focus here on this problem alone. We also do not pretend to give a complete review of all replicatory studies, but believe the most important studies have been selected here for presentation.

In the Pennsylvanian study, Belsky and his colleagues observed 60 middle class mother-child pairs at home. The observations (duration: 45 minutes per measurement) took place in the first, third, and ninth month after birth. A series of maternal behaviors towards the baby were measured, such as maternal responsive vocalization, maternal stimulation/arousal, etc. Infant cry/fuss was also observed. Because a struc-

tured observation system was used, interobserver reliability could be computed, which proved to be satisfactory. Scores on nine measures were added to construct a summary measure for reciprocal interaction. Belsky et al. (1984) considered this to be a quantitative measure for responsiveness. Too much or too little reciprocal interaction was seen as unresponsive, and only the middle of the scale as an indication of responsiveness. The validity of this stimulation measure was proved by expected differences between mothers of securely and anxiously attached children. Avoidant attachment appeared to be a consequence of insensitive overstimulation, whereas resistant attachment seemed to be caused by maternal understimulation. The securely attached children had mothers on an intermediate level of stimulation.

The analysis of the relationship between stimulation, or more specifically the degree of reciprocal interaction, and fuss/cry during the first year of life is of particular interest for our discussion. A cross-lag panel analysis demonstrated that quantity of fuss/cry at an earlier time of measurement did not influence degree of reciprocal interaction at a later time of measurement. The reverse influence, however, could be confirmed. The cross-lag correlations ($-.25$ and $-.32$) were significant. The more stimulation, the less babies cry later on. No curvilinearity was found. This result resists easy interpretation. Some form of unresponsiveness, namely understimulation, appears to lead to more crying, but the second type of unresponsiveness, namely overstimulation, leads to less crying! This certainly cannot be called a replication of the results of the Baltimore study. Belsky et al. pointed to the absence of neonatal evaluations; they hypothesize therefore, that a constitutional difference in infant fussiness prior to the first time of measurement could have been the cause of a certain mode of maternal stimulation. This suggestion, however, contradicts the thesis of Bell and Ainsworth (1972), who observed rather little stability of cry/fuss during the first six months and concluded that constitutional differences could not have played an essential role. Belsky et al. (1984) too, found low, non-significant correlations between cry/fuss across points of measurements.

Crockenberg and Smith (1982) did apply the Brazelton neonatal evaluation, and they therefore had data on constitutional irritability differences. Their results showed that these differences have much less weight compared to differences in maternal attitudes towards responsiveness. Their study only covered the first three months. 54 Mother-infant dyads from middle and working class families in which both father and mother were present were involved. The mother had to complete a 34-item questionnaire through which, amongst other varia-

bles, responsiveness to crying and flexibility in caregiving were measured. Through factor analysis, a general index of responsiveness/flexibility was constructed. On the fifth and tenth day after birth the NBAS was applied. During the first and third month after birth, the mother-infant dyads were observed at home for about 3.5 hours. A structured observation system was used, for which a satisfactory interobserver reliability could be determined. Observations were notated per ten seconds. Concerning maternal behavior, for example, routine contact, involved contact, eye contact, and intervention time (that is: average number of seconds from onset of crying until mother responds) were measured. Concerning the infant's behavior, for example, cry/fuss (frequency of ten second fuss and cry displays) was observed, as well as average time to calm down after intervention in fuss and cry episodes.

In this study, too, cry/fuss did not appear to be stable across time. The same held true for maternal time to intervene. Through hierarchical multiple regression, the influence of neonatal irritability and maternal characteristics on subsequent infant state (fuss/cry and time to calm) was determined, as well as their influence on maternal responsiveness. In the first month, fuss/cry could not be predicted. Irritability did not constitute a relevant variable in this respect. We believe this constitutes a contradiction to Belsky's abovementioned hypothesis. Fuss/cry in the third month could be predicted by "parity" and maternal attitude towards responsiveness/flexibility. Neonatal irritability and one-month infant state were controlled for. First-born children and children with less responsive and flexible mothers fussed and cried more at three months. Although time to intervene (a behavioral measure for responsiveness) and fuss/cry correlated within time of measurements (.43 and .33), the third month correlation did not survive partializing the maternal attitude variable .

On the basis of these results, Crockenberg and Smith (1982) reflected on the discussion between Ainsworth and Bell (1977) and Gewirtz and Boyd (1977). They agree with the first party in the debate, because they conclude: "... observed fussing and crying is associated not with neonatal irritability, but with unresponsive maternal attitudes and behavior" (Crockenberg & Smith, 1982, p.117). We question, however, how far their data justify such a conclusion. Just because maternal behavior in an earlier stage did not influence, at a later stage, the degree of cry/fuss, one cannot speak of a replication of the Bell and Ainsworth results. Maternal attitudes towards responsiveness are theoretically, of course, less relevant than maternal responsive behavior. Conditioning theorists, too, would be little interested in the relation

between attitudes and child behavior. Such a relation would not be considered a threat to the conditioning view on crying as defended by Gewirtz and Boyd (1977).

From a methodological perspective, the Bielefeld study of Grossmann et al. (1985) may be considered the best replication of the Baltimore study. In discussing this study, we shall only focus on the relationship between responsiveness and cry/fuss. 54 Mother-infant dyads from (lower) middle class families participated in the longitudinal study. First, the NBAS was applied three times in the first few weeks after birth. Thereafter, 49 families were visited at home three times during the baby's first year. In the second, sixth and tenth month, about one hour of the two-hour visit was spent on intensive observation of mother-infant interaction. The visits were audio-recorded. Two observers made notes that were written out afterwards. Thus, the same approach as in the Baltimore study was used. The narrative accounts were coded and infant crying and maternal responsiveness among others was measured. Measurements were made of the number of cry episodes, duration of cry episodes (in categories from very short, 1-5 seconds, to long, more than one minute), maternal responsiveness (in three categories: prompt reaction, delayed reaction and ignoring) and type of maternal reaction to crying, as well as a whole series of other variables. It is not clear whether and how time-markers were used, but considering the categorization of central duration variables this probably would have been done rather globally.

The emphasis of the Bielefeld report is on the results of the observations during the tenth month, but all other points of measurement are taken into consideration. Before the tenth month, a correlation between frequency and duration of infant crying episodes on the one hand, and maternal responsiveness on the other hand, were computed. About half of the mothers never ignored a crying episode, and their children cried significantly less often and for shorter periods of time (Grossmann et al., 1985, p.242). Grossmann et al. do not present a correlation coefficient (parametric nor nonparametric). They rated the mothers on the Ainsworth's sensitivity scale, and concluded that maternal sensitivity correlated negatively with the cry measures: the more sensitivity, the less the babies cried. This correlation only concerns the tenth month observations. Unfortunately, the authors did not present correlations for the first two times of measurement, at least not in Grossmann et al. (1981) and Grossmann et al. (1985). Moreover, the authors did not try to determine through cross-lag correlations the influence of maternal responsiveness in an earlier stage on crying behavior later on. In light of the researchers' intention to replicate design and

results of the Baltimore study, a replication of this controversial statistical aspect would have been logical: in principle, relevant data were gathered, but one can doubt the precision and reliability of the frequency and duration measures (see Lamb et al., 1984; 1985). Perhaps some attention will be paid to this topic in future reports.

The fourth study we will briefly discuss here is the cross-sectional study of Landau (1982), done in Israel among five different groups: A middle class and a lower class urban group, a Bedouin group, a Kibbutz group and a group of children from an institution, all participated in the research project. 96 Caregiver-child dyads were involved. Infants were observed in their "natural" environment in their second, fourth, seventh and eleventh month of life. A structured observation system was used, observations were done in half-minute units. The observation sessions lasted about six hours, except with the Bedouin group, which lasted about three hours. Crying and fussing were discriminated: Crying was defined "as a high pitched vocalization of a whining nature, accompanied by tears" (p.434). The same vocalizations without tears were called "fusses". Interobserver reliability was satisfactory.

Results showed a very low frequency of real crying (twenty times less than fussing). The five groups did not differ in crying, and an age effect appeared to be absent as well. In fussing, only the effect of groups did exist: Bedouin, middle- and lower-class groups appeared to fuss more than children from the Kibbutz or the institution. The difference was more pronounced if one only looked at fussing in the presence of familiar people. In that case, most frequent fussing was observed in the Bedouin group and in the lower-class group. Landau supposed these differences to be related to differences in maternal responsiveness. The explicit norm among Bedouin mothers is to intervene promptly if the child starts to fuss or cry. In the lower-class group mothers appeared to spend more time in the presence of the child than the middle-class mothers. In Kibbutzim and institutions, children are reared in groups in which a responsive reaction of the caregivers to crying signals are almost excluded because of the caregiver-child ratio. From these speculations Landau derived the conclusion that "promptly responding to each of the infants' fussing was associated with a higher rate of these responses" (p.439). Such a conclusion, however, cannot be put forward on the basis of a cross-sectional study in which no cross-lag correlations could be computed, and in which the variable "responsiveness" could be determined only in an indirect and probably therefore less valid way.

From the discussion of the four replication studies, we conclude that empirical evidence in favor of Bell and Ains-

worth's hypothesis is lacking. In some studies, a synchronous relationship between crying and responsiveness was found (Crockenberg & Smith, 1985; Grossmann et al., 1985). But efforts to replicate the cross-lag correlations of Bell and Ainsworth (1972) have remained fruitless (Belsky et al., 1984; Crockenberg & Smith, 1982). It is remarkable that the relatively high interquarter correlations of the original study (about .50) have not been reproduced yet. The study of Landau (1982) is, of course, not an exact replication, but it shows that the relationship between fussing (in mild forms) and responsiveness may also be contrary to the results of Bell and Ainsworth. Considering the theoretical and practical relevance of the Baltimore cry study, it is very urgent to start new replication projects. The Leiden study will be reported here. Although not all data have been analyzed yet, we think the available material is sufficient for testing the important hypothesis about the relationship between responsiveness and crying.

METHOD

Subjects

Twenty-five autochton families with both mother and father present in The Hague (the Netherlands), who were contacted through midwives (private practice) in the first week after the baby's birth, served as subjects. All infants in the sample were normal, healthy full terms.

Thirteen of the babies were girls; 12 were boys. Sixteen were firstborn children; 9 were secondborns. The social status of the families was assessed by means of the Bernstein method. Mean = 5.1 (for a scale ranging from 1 to 10; $S=2.3$). Five mothers took on a minor part-time job in the second half of the first year (the father or a grandmother took care of the baby when mother was working). The sample could be described as representative of young, lower to middle class families with two parents in which parental and maternal roles were traditionally allocated.

Procedure

Before the start of the data collection, families were visited at home by the project leader and the female observer to brief the parents and to demonstrate the technical equipment. The hypotheses of the study were not revealed. The general development of the baby was made the central issue and the role of

the parents was carefully kept out of the spotlight. All subjects were visited at home at three weeks intervals during the first nine months. During the visit, the mother and the infant were normally at home. Visits were scheduled at the mother's convenience, the only restriction being that morning, afternoon and evening observations were needed (unfixed order) to get a representative sample of the baby's crying behavior. Mother-infant pairs were visited regularly by one female observer, except for an occasional joint visit made by two observers for reliability checks. Four regular visitors were required to cover the 25 families. A visit could technically be described as a semi-participational non-interventive data collection session within which an observational session *s.s.* took place. During the observational session, the observer was obliged to play a low-profile semi-participant role in order to attend continuously to the ongoing stream of behavior recorded with an event recorder. The observational session was started when the baby awoke and ended approximately 5 minutes after the baby fell asleep. Before and after the observation there was ample opportunity for interviews and normal conversation. The mean total duration of the observations for the first quarter was 4.8 hours; *s.d.*=1.24; Second quarter: 6.5 hours; *s.d.*=2.38; Third quarter: 8.9 hours; *s.d.*=2.0). Of course the visits took longer.

Apparatus

The continuous registration of time-related variables such as duration of crying, the time lag between the end of one cry and the onset of another one; the latency of the mother's intervention is not a simple task for one observer in an unstructured natural setting. In order to cope adequately with this complex situation, the use of technical equipment was necessary. An eventrecorder was used to code the mother-infant interactions continuously. At the same time the vocalizations of the baby were recorded with an FM-audio-registration unit. The eventrecorder and the audio-registration unit were synchronized by a time-code generator developed especially for this research project.

An Epson-HX20 portable minicomputer operating on batteries (software basic) served as eventrecorder. The corresponding coding scheme consists of three coding types: contextual codes (3 digits); behavioral codes (6 digits), and system codes (1 or 2 digits). An example of a relevant sequence is shown here in Table 1).

The sequence starts with a contextual code A4E: the baby is actively awake; no caretaking situation, mother is in another room and can hear the baby cry. Interaction episode 1 (E1)

Table 1
An example of coding interactional sequences

Code type	Time table	Code	Behavioral episode
	uu:min:sec		
context	11:15:00	A4E	--
interact.	11:15:00	ic3mbc	E1
"	11:17:30	meric3	E2
"	11:18:00	mcpic3	E3
"	11:20:00	mphic3	E4
context	11:21:00	ACF	--
interact	11:21:00	illmvp	E5

indicates that the baby starts to cry, while mother is busy in the kitchen (ic3mbc); the next episode starts when mother enters the room and the baby still cries (meric3); E3 starts when mother changes the position of the baby (mcpic3); E4: mother picks up/holds the baby, who is still crying; the next code is contextual, indicating the same behavioral state of the baby and close proximity; E5: the baby initiates this episode looking at the mother (crying stops), and the mother vocalizes positively. In this way, the observation session was segmented into interaction episodes dictated by the behavioral changes of the mother or the baby (or both). The time table shows the start of the interaction episodes. The contextual code does not affect the time table. The task of the observer was reduced to accurately coding behavioral changes with a lettercoding scheme designed to facilitate the actual coding itself.

Audio-registration unit

The audio-registration unit contained three components: (1) a wireless FM-transmitter/microphone combination (type Sennheiser SK 1012(MKE 2012)); (2) an Uher report 4400 portable stereo taperecorder; (3) a FM receiver (type Sennheiser/Telefunken EM 1008). In order to synchronise the eventrecorder and the audio-registration unit by a time-reference axis, a time-code generator was used to write the time (coded by tone-pulses) on track 1 of the tape recorder. The vocalizations of the baby were recorded on track 2. At the beginning of the visit, the time-code generator was connected with the event-recorder to match the two internal clocks. The audio-registration unit was placed in a stand-by operating mode in the living room out of sight for the mother. The FM transmitter/

microphone combination was placed near the baby (approximately 1 meter). The observer was able to check through earphones in the living room if the baby was awake. When the baby awoke the unit was started and could operate for one hour before the tape was full. In the meantime the observer was able to code the interactions of mother and baby with the portable event-recorder.

The technical equipment was chosen to achieve concrete ends regarding the validity of the data. Under all circumstances it should be possible to register the infant crying without being intrusive. If the baby was crying out of earshot of the observer (often also the mother) it was recorded. If the mother wanted the baby to sleep in the babyroom according to her routines during the observation session, this was possible. The observer then remained in the livingroom, checking through the earphones every five minutes out of earshot of the mother if the baby was still awake. The registration of infant crying did not interfere with the perception of the mother and consequently with possible interventions. So the job of the observer was easier than in the Baltimore study, because of the fact that the timing of relevant events was done by the event-recorder and the time-code generator. Bell and Ainsworth (1972, p.1174) remarked: "... observers in their participant roles sometimes found it impossible to time accurately and hence resorted to estimations". Table 2 shows a comparison of the two data collection procedures.

Table 2

A comparison of datacollection procedures

present study	Baltimore study
continuous direct observation	continuous direct observation
semi-participant non-interventive	semi-participant non-interventive
closed observation system registration: eventrecorder; audio-registration unit	open observation system registration: paper and pencil (narrative report); time indicator

Infant crying

Tape recordings were analyzed with a time decoder which displays the time table recorded during the observation. Given

the synchronization of the time table of behavioral episodes (eventrecorder) and the time table of the corresponding tape-recording, an effective quantitative analysis of the infant crying and the interventions of the mother was possible taking into account the codings of the observer. Only the sections of the taperecording corresponding with "no proximity situations" in which the baby could have cried out of earshot were listened to in integral form. Six coders analyzed the distress vocalizations. They were initially trained with a record of infant crying (Wasz-Hockert, Lind, Vuorenkoski, Partanen, & Valanné, 1968). In the case of brief isolated sounds, the distinction between distress and non-distress was made by consensus. Disagreements within a pair of observers were coded as non-distress. If the second evaluation by two main coders yielded disagreements, these vocalizations were also removed from the universum of cry sounds. Every distress signal separated by a pause of two seconds from the next crying instance was coded as a crying episode. The onset and end of every crying episode was noted. Bell and Ainsworth defined the central unit measure, namely the crying episode as any instance of a vocal distress signal (protest, fuss or full-blown cry) not too brief to be timed (on the spot)¹, and separated by more than a momentary pause from another instance (1972). This definition was adopted, except for the rather vague and not replicable value of the two parameters involved, minimal duration and time lag between subsequent crying instances. The present study focused on four definitions of this central unit measure as shown in Table 3, in order to check if the results remain invariant under different operationalizations.

Table 3
Four definitions of crying episodes

min dur ¹	Time lag	
	2 sec	4 sec
1 sec	cell 1,2	cell 1,4
5 sec	cell 5,2	cell 5,4

¹ minimal duration

In the section "results" reference will be made to these operationalizations according to the cells.

¹ remark by the authors

Mother's unresponsiveness

A crying episode was "ignored" by the mother if the intervention started later than 2 seconds after the episode stopped. The duration of mother's unresponsiveness was the difference score between the onset of the intervention and the onset of the crying episode. If a crying episode was ignored, the duration of unresponsiveness equals the length of the crying episode. Maternal interventions were classified as pick-ups, holds; vocalizes; changes position; offers pacifier or toy; removes noxious stimulus; enters room, etcetera.

The focus of this report is on maternal unresponsiveness and not on maternal effectiveness. According to Bell and Ainsworth maternal effectiveness was found to be less powerful than promptness of response in reducing crying in subsequent months.

Reliability

It was difficult to assess the reliability of the observations made by the observers in the home situation, since the presence of one more unfamiliar observer would not be in accordance with the semi-participant non-interventive nature of the data collection by disrupting the normal flow of interaction. Four joint visits were successful. The recording of the infant's crying made it possible to calculate the central measures of crying *post hoc* in such a way that interobserver and intraobserver error variance was eliminated. Thus, the error variance due to measurement on the spot did not play a role, in view of the unpredictable nature of crying behavior. The data for cell 1,2 were coded using a method of consensus, i.e., dropping vocalizations as non-distress if there was any disagreement among coders in a two-stage procedure. Eighty percent of the dropped vocalizations had a duration of less than 5 seconds. A *post hoc* coding of three samples of 20 vocalizations by two coders yielded agreement percentages 85% to 100%, and 70% to 95% against the original codings.

The data of four joint visits provided an indication of the reliability of the mother's unresponsiveness. The onset of verbal interventions available from the taperecorder were excluded, because there is no reliability problem there. The rest of the interventions yielded an agreement score of 82%, 90%, and 95% for the measure "episodes ignored". For the measure "duration of unresponsiveness", the mean deviation score between the two observers was less than one second and 1,5 seconds for the third observation. In all cases the fourth observation yielded onsets of interventions registered on the taperecordings.

Data analysis

The frequency and duration measures for maternal unresponsiveness and infant crying were computed for subsequent quarters and periods of nine weeks in order to obtain stable measures (three for the quarters and four for the periods of nine weeks). Frequency measures and duration measures were analyzed according to Bell and Ainsworth. Frequency measures: % crying episodes ignored by the mother and total number of crying episodes produced by the infant per hour of observation. Duration measures: total duration of the mother's unresponsiveness per hour of observation and total duration of crying per hour of observation. Combining the four operationalizations for the central unity measure (the crying episode) and the two time intervals, eight datasets as shown in Table 4 were analyzed.

Table 4

The eight data sets (combining the definition of the crying episode and time intervals)

Time intervals	Crying episodes defined by the cells			
	cell 1,2	cell 1,4	cell 5,2	cell 5,4
quarters	x	x	x	x
9-weeks	x	x	x	x

RESULTS

Descriptive statistics

Table 5 displays the range, mean, median, and standard deviation for the frequency and duration measures of infant crying, subsequently for the first three quarters. The figures for all four cells (1,2; 1,4; 5,2; 5,4) are shown. Cell 1,2 includes all distress vocalizations and cell 5,2 distress vocalizations with a minimal duration of 5 seconds, etcetera. The mean and median frequency of crying is more or less constant for subsequent quarters. Moreover, the median is very close to the mean, indicating that the distributions are approximately normal. Contrary to the frequency measure, the mean and median duration of crying declines sharply. In the first quarter babies cried (6.5 to 7.2 min./hour) twice as long as in the

third quarter (2.7 to 3.2 min./hour). So babies cried in the third quarter as frequently as in the beginning, but for shorter periods of time. This tendency is similar to that reported by Bell and Ainsworth. In the Baltimore sample, the median duration of crying for the first quarter was 7.7 min./hour, and 4.4 min./hour in the fourth quarter. The present study yielded a median of 6.0 to 6.6 min./hour for the first quarter, and 2.7 to 3.4 min./hour for the third quarter. Thus, the Dutch sample is more or less consistent with the Baltimore sample for the central tendency of the duration measures. There is some discrepancy with Grossmann et al.'s data: The mean duration of crying for the fourth quarter was 1.1 min./hour. On the other hand, there is a discrepancy with the Bal-

Table 5

Range, mean, median, and standard deviation for frequency of crying episodes and duration of crying (min./hour) in the first 9 months

	Frequency and duration of crying											
	First quarter				Second quarter				Third quarter			
	max-min	M	me	S	max-min	M	me	S	max-min	M	me	S*
Cell 1,2 frequency	39-5	21	20	7.9	58-6	22	19	12.1	34-4	20	21	8.7
Cell 1,4 frequency	29-5	16	15	6.0	33-4	16	15	8.0	26-3	15	15	6.5
Cell 5,2 frequency	28-3	13	12	5.6	41-3	13	11	8.0	26-1	10	10	6.1
Cell 5,4 frequency	22-3	11	10	4.5	24-3	11	10	5.3	21-1	9	10	4.8
Cell 1,2 duration	24.1-1.0	7.2	6.3	5.1	13.4-.9	5.0	4.0	3.7	7.7-.7	3.2	3.2	1.8
Cell 1,4 duration	15.9-1.0	6.9	6.6	4.2	13.7-.9	5.3	4.3	3.8	8.0-.7	3.4	3.4	1.9
Cell 5,2 duration	15.4-.8	6.5	6.0	4.1	12.9-.8	4.6	3.7	3.6	7.3-.4	2.8	2.7	1.8
Cell 5,4 duration	15.7-1.0	6.8	6.5	4.2	13.4-.8	5.0	4.0	3.7	7.8-.5	3.1	2.8	1.9

* M = mean
me = median
S = standard deviation

timore study for the frequency measures; Bell and Ainsworth reported a median frequency of 4 crying episodes throughout the first year. The most global operationalization of the crying episode (cell 5,4) resulted in a median of 10 episodes per hour (21 for the most refined operationalization). This figure is similar to the Bielefeld sample for the fourth

quarter (babies cried 10 episodes per hour in the fourth quarter).

Table 6 shows that the distributions of the unresponsiveness measures for the mother also reasonably approach a normal distribution. The mean percentage of episodes ignored by the mother was 40 to 47 for the first quarter, with a strikingly wide range. There is no decline for the central tendency statistics. The range narrows slightly in the third quarter for the cell 1,2 and cell 1,4. The most responsive mother then ignored 6 to 9% of the crying episodes. The duration measure of maternal unresponsiveness declined from a median of 4 min./hour in the first quarter to 2 min./hour in the third quarter.

Bell and Ainsworth reported a similar trend for the central tendency (median) figures, and the absolute figures are also more or less consistent. In the Baltimore sample mothers igno-

Table 6
Range, mean, median, and standard deviation for 'Episodes ignored by the mother'(%), and 'Duration of unresponsiveness' (min./hour) in the first 9 months

	Maternal unresponsiveness											
	First quarter				Second quarter				Third quarter			
	max-min	M	me	S	max-min	M	me	S	max-min	M	me	S*
Cell 1,2 episodes	85-0	47	47	18.7	89-19	52	53	16.7	79-9	48	44	16.3
Cell 1,4 episodes	87-0	44	43	19	86-16	48	48	17	77-6	44	44	17
Cell 5,2 episodes	78-0	44	41	18.7	82-18	49	49	15	83-0	44	44	20
Cell 5,4 episodes	74-0	40	37	17.5	82-18	44	41	15	77-0	39	38	18.8
Cell 1,2 duration	9.9-.9	4.2	4.0	2.4	12.4-2.0	3.6	3.0	3.1	4.3-.4	1.9	1.9	1.0
Cell 1,4 duration	9.9-1.0	4.3	4.3	2.4	12.8-.2	3.8	3.1	3.2	4.5-.5	2.1	2.0	1.1
Cell 5,2 duration	9.7-.6	4.0	3.6	2.4	11.9-2.0	3.3	2.6	3.0	4.0-.3	1.7	1.7	1.0
Cell 5,4 duration	9.8-.7	4.1	4.0	2.5	12.5-.2	3.7	3.0	3.2	4.3-.4	1.9	1.9	1.1

* M = mean
me = median
S = standard deviation

red 46% of the episodes per hour (37% to 47% in the present study) in the first quarter, and 37% in the fourth quarter (38% to 48% in the present study) in the third quarter. The median duration of maternal unresponsiveness was 3.83 min./hour for the first quarter, 2.13 min./hour for the fourth quarter.

Stability of crying and unresponsiveness

An indication of the relative stability of individual differences throughout the first nine months for infant measures and maternal measures is provided by the interquarter correlation figures. We are aware of the pitfalls regarding this procedure but the size of the sample did not allow for any form of panel analysis.

Table 7 shows the interquarter correlation (Pearson product moment) matrices for frequency of crying and duration of crying based on cell 1,4. Similar results were found for the other cells.

It seems that in the first half of the year, crying behavior is more or less stable, but crying behavior in the third quarter is not predictable from the information about the first half year. At this point there is some discrepancy with

Table 7
Correlations between cry variables measured in three quarters (n=25)

Quarter	frequency of crying		duration of crying	
	2	3	2	3
1	.63*	.20	.74*	.14
2		.25		.27

* $p < .001$

the Bell and Ainsworth report. The Baltimore study yielded only a significant rank order correlation between the third and fourth quarters. Nevertheless, the results of the present study point to a lack (or at most marginal effects) of possible constitutional differences in crying.

Table 8 shows the interquarter correlations for episodes ignored and duration of unresponsiveness (based on cell 1,4). For the frequency measure the correlations between the first and second quarter and the second and third quarter respectively are significant. For the other cells, only the first correlation was significant. The duration of unresponsiveness seems only stable for the first half year.

Bell and Ainsworth reported stable maternal tendencies throughout the year for responding to crying (probably influenced by the mother's personality) based on interquarter bivariate correlations.

Table 8

Correlations between unresponsiveness variables measured in three quarters (n=25)

Quarter	Episodes ignored		Duration of unresponsiveness	
	2	3	2	3
1	.54**	.10	.70***	.10
2		.34*		.19

* $p < .05$

** $p < .01$

*** $p < .001$

Infant crying and maternal unresponsiveness

First, bivariate correlations were computed for maternal unresponsiveness and infant crying. Given the hypothesis that the behavior of the mother in a certain period of time is an important pedagogical determinant (independent variable) for infant crying in subsequent periods (dependent variable), a selection of possible correlation indices were inspected. Table 9 shows the rank order correlations (Spearman's Rho) for the frequency measures, based on cell 5.2

All other cells yielded non-significant coefficients. The tentative interpretation of Table 9 is that mothers who ignored more episodes of crying in the first quarter tend to see their babies cry less frequently in the second quarter. The results are similar for the period of nine weeks, also for the relationship between the second and the third period.

Contrary to the frequency measures found less important by Ainsworth and Bell (1972, p.245), the bivariate correlation for the duration measures was significantly positive for the first and second quarter (see Table 10).

On the basis of similar positive correlations throughout the whole year, Bell and Ainsworth (1972) concluded that those mothers tending to give a more delayed response in one quarter, would see their baby cry more in the next one. This incorrect conclusion based on spurious correlations would apply only for the first half year for the present study, because the correlation between the second and the third quarter was positive, but not significant. The uncorrected measures yielded a substantially high correlation (.94) within the second quarter. Measures were not artificially corrected for intra-quarter relationships, because this correction does not make

Table 9

Spearman correlations between number of episodes ignored by the mother and frequency of crying (n=25)

Episodes ignored by mother	Frequency of crying (cell 5,2)				
	2nd quarter	3rd quarter	2nd 9 wks	3rd 9 wks	4th 9 wks
First quarter	-.33*	-.07			
Second quarter		-.04			
First 9 weeks			-.33*	-.36*	-.08
Second 9 weeks				.09	-.12
Third 9 weeks					-.15

* $p < .05$

any sense (cf. Gewirtz & Boyd, 1977; Ainsworth & Bell, 1977). There is a basic interdependence between infant and maternal measures. However, controlling for intra-quarter maternal duration of unresponsiveness addresses the criticism of a synchronic concurrent variable (Gewirtz & Boyd, 1977). Partialling out the unresponsiveness of the mother resolved the positive relationship immediately. Similar results were found for all cells. The conclusion cannot be any other than that the results of Bell and Ainsworth's sample for the duration measures were found without partialling and were not found by controlling for a synchronic concurrent variable for the first half year. The results for the periods of nine weeks are consistent throughout the period of 27 weeks (= half a year). Only for cell 5,2 and cell 5,4 was the inter-period correlation between the second and the third period not significant, but the overall tendency was positive. For the period of nine weeks the partial correlation became even significantly negative, quite a radical change. This strikingly unexpected result indicates that mothers who tend to be more unresponsive in a certain period of time have babies who cry less in a subsequent period. This interpretation seemed to contradict the Baltimore study and is consistent with the findings of Landau (1982) and Moss (1972). Before jumping to conclusions it seems appropriate to seriously scrutinize the criticism of Gewirtz and Boyd. They justifiably stated that not only synchronic concurrent variables were ignored by Bell and Ainsworth, but antecedent concurrent variables as well (Gewirtz & Boyd, 1977). The most important antecedent variable is the crying behavior of the baby in a preceding period. Given the

Table 10

Product moment correlations between duration of maternal unresponsiveness and duration of crying (n=25)

Duration of unresponsiveness	Duration of crying (cell 5,2)				
	2nd quarter	3rd quarter	2nd 9 wks	3rd 9 wks	4th 9 wks
1st quarter	.64*(.06) ¹	.17			
2nd quarter	.94*	.28(.10)			
1st 9 wks			.65*(-.51*)	.50*	-.05
2nd 9 wks			.97*	.34(-.11)	.00
3rd 9 wks			.37	.97*	.10(.03)

* p < .01

¹ in brackets: partial correlations, controlled for second quarter, etc.

small sample size (n=25), the antecedent variable was controlled for artificially by regarding the change in crying behavior in subsequent periods or quarters as the dependent variable. A cross-lag panel analysis based on latent structural equation analysis is not statistically justified (Boomsma, 1982). The change in crying behavior was defined as the quotient of the difference score between two periods and the score in the preceding period. This variable resembles the development of the durational or frequency measure, incorporating initial differences between infants. If crying behavior changes more or less to the same degree within the sample, the correlation between this variable and the predictor variable should not be found significant. Individual scores will be positive as infant crying undergoes relative increases, and negative in the case of a decrease. We are aware that the difference score as a measure for change in the case of a multiple operationalization of a construct could be criticized (Lewis, 1985). This variable, however, has predominantly concrete features, so that, given the accuracy of the measurement procedure, measurement at two successive points is not invalidated by regular pitfalls.

Table 11 shows the correlation matrix of the variable "change in crying behavior" with mother's unresponsiveness for preceding periods partialling out the responsiveness in the synchronic quarter. These partial correlations are based on cell 5,2.

Table 11

Product moment correlations between duration of maternal unresponsiveness and change of duration of crying in the next period or quarter (n=25)

Duration of maternal unresponsive-ness	Change of duration of crying (cell 5,2)				
	2nd quarter	3rd quarter	2nd 9 wks	3rd 9 wks	4th 9 wks
First quarter (contr. for second quarter)	-.81*	n.s. ¹			
Second quarter (contr. for third quarter)		-.53*			
First 9 weeks (contr. for second 9 weeks)			-.51*	n.s.	n.s.
Second 9 weeks (contr. for third 9 weeks)				-.47*	n.s. ²
Third 9 weeks (contr. for fourth 9 weeks)					-.45*

* $p < .01$

¹ not significant

² controlling for the fourth nine weeks

The partial correlations are substantially negative. The results are similar for all other cells, based on quarters or periods of nine weeks. Findings were consistent for duration measures and frequency measures. Thus, this finding is very stable and conservative. It is interesting to note that controlling only for the synchronic concurrent variable yielded no relationship between maternal duration of unresponsiveness and duration of crying (cfr. Ainsworth & Bell, 1977; referring to a reanalysis of their data by Gewirtz & Boyd for the quarters). Further controlling for the antecedent concurrent variables resulted in a negative relationship. The results could then be described as an empirical basis for the conclusion that mothers who tend to delay a response more in a certain period had babies who cried less frequently and shorter in

subsequent periods. This conclusion contradicts the findings of Bell and Ainsworth.

CONCLUSIONS

In the introduction of this chapter, we stressed the important role of the Baltimore study in radicalizing the attachment theoretical ideas concerning the relationship between responsiveness and crying. Initially, crying was sophisticatedly conceived as a graded signal to which different meanings could be attributed depending on intensity, temporal structure and context. In the period following the Baltimore study, crying became an undifferentiated, on/off signal to which the caregiver(s) should always respond as quickly as possible (except on very rare occasions when responding is obviously inappropriate).

Being familiar with the studies by Wolff (1969), Bowlby (1971) was aware of the fact that not all crying behavior is a signal of fear or a call for proximity. One could argue that only full-blown crying with a strident nature (severe distress because of pain, existential fear), should be unequivocally conceptualized as attachment behavior, with evolutionary origins. For milder forms of distress vocalizations (whimpering, fussing), this is not self-evident. This also implies a differential response of the caregiver(s): a fixed response pattern promoting proximity to the baby in case of a compelling form of crying (i.e., a cry with a long expiration pause), and a variable, contextually defined response pattern given forms of a mild distress vocalization.

The striking (but probably false) results of the Baltimore study tempted Bell and Ainsworth (1972) to classify all crying behavior as attachment behavior and to stipulate that responsiveness is predominantly a promptness of response, without taking into account the quality of the response, such as adequacy (Lamb & Easterbrooks, 1981). They justified this point of view by referring to their empirical findings that promptness of response was found to be more effective in reducing crying in subsequent months than maternal effectiveness in terminating crying. We have outlined the Baltimore study in the preceding paragraphs and referred to criticisms by Gewirtz and Boyd (1977) and Lamb et al. (1985). Despite the fact that Ainsworth and Bell (1977) admitted the non-conclusive nature of their study and emphasized the urgency of replication, the first research project covering the Baltimore study has yet to be reported. Research by Belsky et al. (1984), Grossmann et

al. (1985), Crockenberg and Smith (1982) and Landau (1982), did not replicate the Baltimore study, and the results are not congruent.

What is needed is a critical replication study directly recording the measures for infant crying, and preserving the intensive naturalistic longitudinal aspects of the study. However, at the same time it should aim at more refined registration procedures and statistically justifiable analyses.

The present study is such an effort. The results are more or less convergent regarding univariate descriptive statistics for the two samples. Similar findings were repeated for bivariate interquarter correlations for duration of maternal unresponsiveness and duration of infant crying for the first half year. In other words, positive significant bivariate correlations were found similar to those on which Bell and Ainsworth based their conclusions. Had synchronic and antecedent concurrent variables not been controlled for in this study, one could (falsely) conclude that a relatively longer duration of the mother's unresponsiveness in the first quarter covaried with a longer duration of crying in the second quarter. Controlling for antecedent and synchronic concurrent variables revealed that the observed relationship was due to spurious correlations. The relationship proved to be quite the opposite when a stable picture of negative partial correlations was unfolded, leading to the conclusion that there is an inverse relation between the mothers' unresponsiveness and infant crying. Moreover, this pattern of negative correlations proved to be consistent for all possible operationalizations used in this study, indicating some robustness or conservativeness of these findings. The data indicated that mothers who tend to delay their response relatively longer effected a decrease in infant crying for the next period or quarter.

How should one interpret this unexpected result? For the development of infant cry/fuss in the first year, at least three models are relevant. The *organistic* model stresses the predominant effect of initial constitutional differences in irritability. The data of the present study suggest that in the first half year, individual differences in crying behavior are relatively stable given the inter-quarter correlations. This suggestion is merely tentative but nevertheless this model is inadequate to explain the rest of the reported results. Research concerning the irritability factor revealed minor effects of this factor (Crockenberg & Smith, 1982; Grossmann et al., 1984), and generally speaking the relationship between mother-infant interaction and constitutional factors, i.e., temperament, is still very confusing (Sroufe, 1985). To postulate that fussiness has nothing to do with mothering (as was done by Belsky et al., 1984, p.727) is not

very plausible. This model simply does not fit the results of the present study regarding the covariation of maternal unresponsiveness and crying.

A second model is the *conditioning* paradigm. Gewirtz (1961) made some efforts to demonstrate experimentally that mother and infant reinforce each other's behavior differentially, and so acquire mutual control of one another, or develop something resembling a form of attachment. An evolutionary component was regarded as redundant. Bowlby (1971) did remark that nothing whatsoever in the conditioning approach "contradicts the view advanced here (but) it tends to give too little attention to the strong innate biases that, it is held, each partner brings to the partnership" (p.266). These innate biases should not be overlooked as this may result in falsely construing every behavioral system as environmentally unstable (cf. Ainsworth, 1973). As Bowlby would say, we cannot do whatever we want with our biological inheritance. This point of view has been taken seriously by Petrovich and Gewirtz (1985). The conditioning theory as the theory of proximate causes was complemented with evolutionary reflections about ultimate causes, being very similar to reasoning in an attachment-theoretical framework (cf. Lamb et al., 1985). Attachment behavior is linked to the expansion of inclusive fitness by upgrading the reproductive success of the individual. This is the evolutionary basis for developing complex forms of "psychobiological attunement" (Field, 1985) between babies and parents: "simply stated, the greater the number of genes shared, the greater the probability of dyadic interactions indicative of affect, attachment, and/ or attunement", as stated by Petrovich and Gewirtz (1985, p.235). The difference between this revised conditioning theory of attachment and the Bowlbian theory seems to be the use of the conditioning paradigm for the description of the proximate causes for attachment as suggested by Petrovich and Gewirtz (1985, p. 276). However, this suggestion is incorrect, because Bowlby (1971, p.374) obviously leaves room for reinforcement of behavior by conditioning, i.e., feedback on certain behaviors of the child by a responsive caregiver. This learning mechanism undoubtedly has a place along with other "causes" for the development of attachment, such as an built-in bias and "exposure learning" (p.374). It is clear that conditioning theory in its most recent terms cannot be considered incompatible with the attachment theory.

It is tempting to interpret the inverse relationship between unresponsiveness and infant crying as the result of an extinction mechanism due to a lack of reinforcement given by the mother. But this interpretation does not adequately account for the evolutionary origins of behavior, i.e., crying behavior as conceived by the revised conditioning theory.

Bowlby and Ainsworth stated very plausibly in their attachment theory that crying behavior had fulfilled a role in the evolution of the species by promoting proximity of a protecting companion to a helpless baby. It seemed that this role, however, is fulfilled by an unequivocally interpretable form of crying, calling for or inducing an equally unequivocal reaction (Murray, 1979). This should be a form of crying indicating severe distress (e.g., crying with long expiration pauses, etc.). Viewed from an evolutionary perspective, there is only one adequate response and this is bridging the distance and eliminating or changing the conditions that caused the crying behavior. Babies who fail to get an adequate response will emit an alarming vocal signal in the case of declining threshold values of distress. In the case of milder forms of distress vocalizations the situation is different to the former one described. The evolutionary role of this form of crying behavior is less obvious, and the information to the caregiver is not clear cut. The question remains if a delayed response of the caregiver does not enable the infant to cope with the mild distress by itself (cf. Landau, 1982). This would result after a while in a reduction of fussing behavior; "this might happen because being able to cope under such conditions will make the situations less stressful in the future" (Landau, 1982, p.441). This seems to be an accurate description of the behavior of a responsive mother, also in the Baltimore study: "Even the most responsive mothers did not respond to a little cry that stopped spontaneously when a baby was put to sleep or a similar brief fuss when a baby was trying to turn over and could not manage by itself, however, succeeding next. But rarely did they fail to respond to a loud and prolonged cry" (Ainsworth, personal communication; Landau, 1982, p.440).

Although in the present study different types of crying were not analyzed separately, we have the impression that less than 20% were vocalizations indicating severe distress. Given the thesis that only severe distress vocalizations should be conceptualized as attachment behavior, one might infer that an explanation in terms of conditioning could be relevant. This does not imply that alone ignoring fussing behavior is adequate, but also responsive reactions to behaviors that are concurrent with crying, such as smiling, exploration, etc. (cf. Etzel & Gewirtz, 1967). Responsive reactions during a calm state that tends to turn into crying might be a better - indirect - intervention against excessive crying behavior than any form of negative reinforcement to fuss/cry (cf. Fouts, 1974; Lester, 1985, p.25). Thompson and Lamb (1983) criticized research regarding crying as a simple on/off signal. Mild whimpering, fussing, angry protest, sobbing and

hyper-ventilated crying or screaming should not be confounded. They advocate the conceptualization of crying as a differential or graded signal. On the basis of this present study, we suggest that responsiveness, too, is falsely conceived of as an on/off signal. We would suggest the term *differential responsiveness*: Given the intensity and temporal structure of crying, a delayed or *prompt* response is adequate. In accordance with the hypothesis of differential responsiveness it is relevant to react promptly to alarm signals. These signals are seen as authentic attachment behavior with the function of bridging the distance to a caretaking or protective companion. The adequate answer is a prompt reaction aiming at proximity and a change in the conditions that cause the emittance of the alarm signal. Further responsiveness is relevant for behaviors which are concurrent with crying, i.e., smiling and exploration. If a calm state tends to shift to fuss or cry, then a responsive intervention can continue this state and prevent crying. In such a way the baby also develops a sense of controlling and influencing the environment. Responsiveness is correctly regarded in the attachment theory as relevant for developing a feeling of competence. The present study, however, demonstrated that a mere prompt response of the mother to all forms of cry/fuss could turn out to be counter-productive. One should be aware of the fact that prompt reactions of the mother reinforced fussing behavior. The notion of differential responsiveness implies that given milder forms of fussing, a (positive) disposition towards delayed reaction is adequate, for this form of crying does not appear to have evolutionary origins in a strict sense.

This interpretation could be strengthened by pointing to the inclusive fitness variant of an ultimate explanation of attachment (Lamb et al., 1985). In this variant the caregivers aim at maximalization of reproductive success. This could imply that they do not react responsively to certain behaviors of a baby in specified contexts, because a reaction is not in keeping with the well-being of other offspring. Parental attention should in general be divided between several children and it is not plausible to assume that evolution compelled parents to respond to every cry/fuss if they do not wish to disfavor the other offspring. Hinde (1982) suggested that it is not according to reason to assume that evolution has culminated in a uniform type of mother-child interaction. Babies who are insensitive to temporal unresponsiveness because their siblings needed attention are perhaps well-equipped in terms of fitness in the struggle for life.

So the hypothesis of differential responsiveness implies that maternal unresponsiveness has an increasing effect on severe distress vocalizations and a declining effect on mild

forms of distress vocalizations. This notion is coherent within the context of a sophisticated attachment theory as outlined by Bowlby. The relationship between unresponsiveness and crying is hypothetical because this critical replication study yielded one obvious result by falsifying the thesis of Bell and Ainsworth (1972) that consistent promptness of response tends to decrease an infant's readiness to use crying as a signal (p.1180). The statement may mean that one should respond differently to different forms of crying. The present study did not differentiate between severe distress vocalizations and mild distress vocalizations. Consequently, the hypothesis about a complex relation between unresponsiveness and crying was formulated, in accordance with Bowlby and Wolff.

The present study does not permit the conclusion that one of the cornerstones of the attachment theory should as yet be considered falsified. Referring to the original formulations of the attachment theory by Bowlby, the radical interpretation of Bell and Ainsworth should be dropped, although the generalization of these results is limited to the universum of non severe distress vocalizations. These results do not apply to other signals of the baby. Further research concerning the relation between different forms of cry/fuss and responsiveness, e.g., with the Thompson and Lamb scale (1982), is necessary to test the hypothesis of differential responsiveness. The reactions of the caregivers to positive signals of the baby, i.e., signals preceding crying behavior, is very important in this context. Perhaps one should then conclude that a high grade of responsiveness can prevent crying but does not reduce crying once it has started.

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