INFANT CRYING AND MATERNAL RESPONSIVENESS: CONTINUITY, CHANGE AND THE DIRECTION OF EFFECTS.

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ABSTRACT

An observational study of a group of mothers and their first-born infants was conducted to determine the long-term effects of maternal responsiveness to cries on the amount of infant crying and, conversely, to assess the contribution of the amount of infant crying to changes in maternal responsiveness to cries. The study was also designed to enable a comprehensive description of age changes in crying, those events which predictably precede crying and the relationship between crying and infant social behaviour. Maternal behaviour during interaction was also recorded to enable specification of responses typically made to cries, the effectiveness of such responses, and the relationship between the mother's behaviour in response to cries and the quantity and quality of her input into interaction with the infant.

Eighty-two pregnant women, from whom the final sample was derived, were recruited through newspaper advertisements and pre-natal classes. All the expectant mothers were white, middle-class, well-educated and married. Women were excluded from the final study if they experienced significant illnesses or problems during pregnancy or if they fell outside the optimum range (20-35) for obstetric functioning. Similarly, mothers who delivered low birth weight, premature or sick infants requiring intensive care were excluded. The final sample, selected to ensure an equal number of male and female infants, consisted of 54 mother-infant pairs.

The women who agreed to participate were interviewed during the third trimester of pregnancy, when the investigation was explained to them and relevant demographic data collected. In addition, they completed a questionnaire on child rearing practices which included items specifically relevant to the management of crying.

After the birth of the infants mothers and infants were observed in their homes when the infants were 2 weeks, 3 months and 6 months old. Each observation session, conducted only while the infant was awake, was two hours long. Observations were coded according to a pre-determined schedule and recorded using a portable electronic real-time recorder (DART II). This enabled the specification of the time of onset of every codeable event, as well as the duration and patterning of such events.

Results obtained showed a clear decline with age in the amount of infant crying and a corresponding increase in the amount of smiling, vocalising and looking at the mother. There were considerable individual differences in both these variables and by six months those infants who cried most also showed the most social behaviour. In addition, the amount of crying at two weeks and three months also predicted the amount of infant social behaviour at six months. Those infants who were initially most irritable showed the most smiling, vocalising and looking at the mother during interaction at six months and were also the most responsive during that interaction. A number of events were found to be reliable antecedents to cries. Of these, loss of physical contact with the mother was the most consistent in eliciting cries over the six months of the study.

Mothers were initially very "permissive" in their management of crying, responding promptly to a high proportion of their infants' cries. This was consistent with views they had expressed before the birth of the infants. Those mothers who had the most "permissive" attitudes at this time were also the most responsive to crying at two weeks. Over the six months there was a decline in both promptness in responding and the proportion of cries to which mothers made response, as well as a shift towards less "permissive" attitudes regarding the appropriate management of crying. The level of responsiveness was also shown to depend on the form of the crying episode. Isolated cries and sequences beginning with a cry were responded to more frequently and promptly than isolated fusses or sequences beginning with a fuss.

Several predictable responses to cries were identified. These were shown to depend on the nature of the event which preceded the cry. For example, mothers responded to cries preceded by putting the infant down, by picking the infant up again. Furthemore, responses tailored to the nature of the preceding event were the most effective in terminating cries. This pattern had changed somewhat by six months when the nature of maternal response was less clearly related to the precipitating event and was more likely to involve playing with and distraction of the infant.

Mothers who ignored a high proportion of cries and delayed in responding were just as likely as more responsive mothers to involve their infants in interaction. Furthermore, the quality of such interaction was not related to their behaviour in response to cries.

Causal modelling of the correlations obtained over the six months showed that it was the frequency of infant crying which modified maternal responsiveness to cries and not vice versa. Over the period of the study the amount of crying was a highly consistent attribute unaffected by the degree of maternal responsiveness. On the other hand, mothers clearly modified their behaviour on the basis of the amount of crying shown by their infants, with mothers whose infants cried most at 2 weeks exhibiting the lowest levels of response to cries at 6 months.

It was concluded that, contrary to the apparent consensus in the research literature and in child care manuals, the amount of infant crying is a stable characteristic which is not easily modified by maternal responsiveness, at least within the range sampled in this study. Rather it is mothers who modify their behaviour in response to the level of crying characteristic of their infants.

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INTRODUCTION

This report describes a single, naturalistic, longitudinal study of a sample of mothers and their first-born infants followed up over the first six months from birth. The focus of the study is on infant crying which occurs in the home environment. Crying was singled out for study because it is the earliest and most perceptible signal at the infant's disposal. It is not easily ignored and frequently elicits a prompt response from the infant's caretakers. Both theory and research point to its potency as a determinant of maternal behaviour and attest to its importance in linking the mother and infant (Bell & Ainsworth, 1972; Bowlby, 1969; Moss, 1974; Murray, 1979). Furthermore, the nature and promptness of maternal responses to cries, have been argued to have long-term effects on both the nature of the mother-infant relationship (Moss, 1974) and the characteristics and behaviour of the infant (Ainsworth, 1977; Bell & Ainsworth, 1972). Although the principal focus of this study is on such long-term changes, it is important to understand the context in which they occur. As both McCall (1977) and Moss (1974) have suggested, the basis for any study of the relationship between behaviours of interest should be a systematic description of the dimensions and circumstances of these behaviours in the settings in which they naturally occur. For this reason this investigation is not confined to observation and analysis of infant cries and mothers responses to cries. It also includes a detailed analysis of the pattern of interaction between mothers and infants, the aim of which is to ascertain the relationship between crying and responsiveness and the quantity and quality of other behaviours, particularly those which precede and follow crying.

Style of Presentation

The literature review, results and discussion have been organized around three major themes: infant crying, mothers' responses to crying and the long-term reciprocal relationship between infant crying and maternal responsiveness.

Chapter 1 begins with a review of attachment and learning theory explanations of why babies cry. There follows a critical assessment of the evidence on those circumstances which appear to elicit crying. The issue of whether cries can be distinguished by their acoustic properties is examined and the findings on the relationship between the nature of a crying episode and the events which precede it are reviewed.

Theory and evidence on what motivates mothers to respond to cries is outlined in Chapter 2. Difficulties in providing an adequate empirical test of this question are indicated. The significance of maternal beliefs about the appropriate management of crying is then discussed. This is followed by discussion of the question of whether these beliefs are systematically related to mothers' responsiveness or to the amount of crying exhibited by their infants. Finally evidence on the nature and effectiveness of mothers' responses to cries is reviewed.

In Chapter 3 three competing approaches to the long-term relationship between infant crying and maternal responsiveness are described. Evidence adduced in support of each position is reviewed and critically evaluated. The conditions necessary for an adequate test of the validity of each of the approaches are detailed. There followes an examination of the possible influence of other maternal and infant behaviours on the variables of interest. The chapter concludes with the specification of research aims for both group and individual data.

Chapter 4 is a description of the method used in this study and begins with a report of the characteristics of the subjects studied. A description and justification of the methods of data collection follows. The recording equipment and behaviour codes are described together with the methods used to assess the reliability of the codes. The procedural details of the study are then reported. The chapter concludes with a brief description and justification of the two major data analysis techniques used: Lag Sequential Analysis and Causal Modelling.

Chapter 5 contains a report of results on infant crying, including age changes in the frequency and duration of cries, daily patterns of crying, the extent and consistency of individual differences in crying, the events which precede crying, and the relationship between preceding events and the form of the resulting crying episodes. The correlations between crying and other infant behaviours are detailed. These results are compared with those obtained in other studies and are discussed in terms of attachment and learning theory explanations of why babies cry.

Results on mothers' attitudes and behaviour in response to cries are presented in Chapter 6. The chapter begins with a description of mothers' attitudes to the management of crying and changes over time in these attitudes. Similar changes in both the percentage of cries responded to and mean latency to respond are detailed. Following this is an analysis of the relationship between pre-natal attitudes to the management of crying and responsiveness to cries during the six months of observation. The association between the amount of crying exhibited by infants over the six months and mothers' attitudes to crying after that period is then described. Results on maternal responses which are contingent on fussing and crying at each age are outlined together with data on the average latencies of such responses. The relationships between the circumstances which precede fuss-cry events and the likelihood, promptness and nature of maternal responses are then detailed. The effectiveness of various responses in terminating cries is also described. The results section of the chapter concludes with an analysis of the relationship between measures of maternal responses to crying and indices of the quantity and quality of maternal behaviour during interaction with the infant. All these results are discussed in the latter part of the chapter.

The final chapter (7) consists of results from causal modelling of the relationships between the amount of infant crying and the level of maternal responsiveness. Correlations, structural equations and the best-fit models are detailed. Individual data, necessary for an analysis of the behaviourist approach, are also outlined. Long-term relationships between measures of infant crying and social behaviour are then presented before examining limitations of the major data analysis techniques used in the study. The implications of the major findings are discussed and discrepancies with previous findings in the area evaluated. The chapter concludes with a discussion of the extent to which the major findings permit conclusions about continuity and change in infant crying. Suggestions are made for future research.

CHAPTER 1

INFANT CRYING

1.1 Why Do Babies Cry?

At the basis of any attempt to understand infant crying and long term changes in crying is the question: "Why do babies cry?" This question has typically been interpreted in one of two ways. First, and most fundamental, is the issue of what crying means, what function it serves in the relationship between infant and caretaker. A second approach has focused on determining which stimulating conditions elicit crying and whether different stimuli produce different cry 'types'. Each of these issues is discussed in turn.

1.2 What Does Crying Mean?

Many of the attempts to address this question have taken the form of speculation about the importance of crying in promoting survival of the relatively helpless and undeveloped infant (Ainsworth, 1969; Bowlby, 1969; Murray, 1979). In general terms, this has led to theorising about the adaptive significance of the cry in human evolution. The other major group of explanations has been derived from leaning theory, particularly the principles of operant conditioning.

1.2.1 Attachment theory

In the view of attachment theorists such as Ainsworth (1969) and Bowlby (1969), crying is one of several innate attachment behaviours which evolved to promote and maintain proximity of the infant to the adult caretaker, usually the mother. Bowlby has made a distinction between signalling behaviours, such as smiling, crying and other vocalisation, which attract adults to approach and remain close-by, and active behaviours such as sucking, rooting and grasping, which serve to maintain contact once it has been achieved.

Each of these behaviours is conceived of as a fixed-action pattern, with its own causes of activation and termination.

The underlying assumption is that crying, like other attachment behaviours, evolved to perform a protective function by bringing the infant into close contact with adults who could then defend against predators and other dangers. Bowlby (1973) has suggested that there are a number of situations which provide "natural clues" to danger. Not dangerous or painful in themselves, they are said to have been associated so frequently with danger throughout the evolutionary history of the species that fear in response to them has been selected as advantageous for survival. For humans, as well as for a variety of other species, being alone is one such "natural clue".

Both Bowlby (1969) and Ainsworth (1969) have proposed that behavioural systems, such as the attachment system, which are concerned with reproduction and care and protection of the young, appear in much the same form in all members of the species despite wide variation in the environments which they inhabit. They have argued that although proximity is no longer essential for adequate protection in contemporary societies, babies are, nonetheless, genetically programmed to cry when out of contact or distressed, and that their behaviour is adapted to the prototype of the responsive caregiver, "a mother who is continuously nearby and who is responsive to the infant's signals" (Ainsworth, Blehar, Water & Wall, 1978, p.55). Although other events have been acknowledged as likely to precipitate cries, much of the emphasis within attachment theory has been on the infant's response to separation.

Both Bowlby (1969) and Ainsworth (1969) have argued that crying and other attachment behaviours are likely to be activated because the principal attachment figure departs or a stranger approaches. They argue that while infants are initially "undiscriminating and indifferent" as to the attachment figure, they gradually focus proximity seeking behaviours on one or few figures, usually the mother.

It is equally plausible in terms of the survival argument that infants form rapid, virtually instantaneous attachments to a specific figure via mechanisms similar to those observed in the process of imprinting. Macfarlane's (1977) finding that newborn infants can reliably discriminate their mother's breast milk from that of other mothers suggests a possible discriminative basis for such attachment.

A close reading of the Bowlby-Ainsworth argument suggests that, since the very young and vulnerable infant apparently lacks the experience and cognitive maturity which would enable it to determine the significance of events (e.g. who is familiar, when the caretaker departs or returns), the most adaptive response in terms of survival would be to cling firmly to any caretaker and signal volubly by crying whenever out of physical contact with that figure. Since the newborn's ability and means to cling are significantly reduced in humans compared with other primate species (Konner, 1977), and since smiling does not develop until several weeks after birth, the sole proximity promoting response at the newborn's disposal would appear to be the cry. In other words, crying should be reliably precipitated whenever the infant is out of contact. Unfortunately, there is little evidence on this question, since most of the studies on brief separations have been conducted with older infants, although Ainsworth's own observational study (Bell &

Ainsworth, 1972) did show that 74% of cries exhibited by infants less than three months old had their onset when the babies were not in contact or proximity with the mother.

Subsequent focusing of attachment behaviours on one, or very few, specific figures is assumed to depend on the infant's experiences with those figures and on the development of the concept of object permanence, the capacity to conceive of the mother even in her absence (Bell, 1971; Bell & Ainsworth, 1972). An additional pre-requisite is that infants should be able to discriminate among persons so that they will be aware of when the mother is present and when she is not (Schaffer and Emerson, 1964).

There is a substantial literature on the older infant's response to departure or absence of the mother (Ainsworth, 1977). "Separation distress" is a phenomenon which appears to develop in the second half of the first year of life and apparently occurs in a number of different cultures (Ainsworth, 1977; Konner, 1972). Bowlby's description of the effects of separation indicates the expected developmental course of the separation response.

> "During the first year an infant protests especially when put down in his cot and, a little later, on seeing his mother disappear from sight. Subsequently a child who, when his mother leaves him, is otherwise engrossed, begins to notice that she is gone and then protests. Henceforward, he is keenly alert to his mother's whereabouts...During his eleventh or twelfth month he becomes able, by noting her behaviour, to anticipate her imminent deparure, and starts to protest before she goes"(1969, p.204).

In Bowlby's view the departure and absence of the mother almost inevitably activates attachment behaviour. This is mediated by the infant's innate sensitivity to being alone as a cue to danger. However, it is clear that not all infants exhibit such separation distress and, furthermore, that it is not a reliable phenomenon even in those infants who do (Masters & Wellman, 1974).

The research evidence offered in support of these conclusions is based largely on studies of brief laboratory separations. They show that when the mother leaves her year old infant in the laboratory playroom and shuts the door behind her, the infant usually cries, ceases playing and may attempt to follow (Ainsworth *et al.*, 1978). Although this phenomenon has been interpreted widely as evidence of the infant's attachment to a specific figure, usually the mother, it may equally reflect processes such as the infant's lack of understanding of discrepant events. Much of the crying evident in laboratory separations may be due to the novelty of the environment or the nature of the mother's departure. One frequently cited study of separation protest in the home showed that among the small proportion of infants who cried, crying was more common when the mother left the room through a rarely used exit such as a closet or cellar door (Littenberg, Tulkin and Kagan, 1971). In addition, separation, protest is considerably delayed, even completely absent, when novel toys are made available to the infant before the mother departs (Corter, Rheingold and Eckerman, 1972). However, such protest does seem to be directed to the mother when it occurs (Corter, 1973), although infants do not necessarily cry when left alone with a stranger. Nonetheless when the infant is left completely alone and begins crying, an unfamiliar person is usually relatively unsuccessful in terminating the cry (Ainsworth *et al.*, 1978).

A substantial amount of criticism has been directed at Bowlby for his "monotropic, matricentric model of early interpersonal preference" (*sic*) (Kotelchuck, 1973). Careful observation has revealed that 70% of infants direct attachment behaviours including 'separation protest' toward their fathers as well as to their mothers, with 25% apparently showing an active preference for the father (Kotelchuck, 1973).

1.2.2 Learning theory

An alternative interpretation of the meaning of cries and of events surrounding 'separation protest' is based on learning theory principles (Cairns, 1972; Fleener and Cairns, 1970; Gewirtz, 1977). This forms the basis for Gewirtz's interpretation of the long term relationship between crying and maternal response. Gewirtz makes a distinction between elicited or distress crying, exhibited when the infant is hungry or in pain, and operant or communicative crying which apparently depends on the location of the mother, although he points out that this distinction may be difficult to maintain in practice.

With respect to operant crying, Gewirtz (1977) has argued that:

> "insofar as contingent maternal responding provides positive reinforcing stimuli for infant cries and protests, it may be assumed that these responses will come readily under the control of cues denoting the physical distance, departure or absence of a parent" (p.45).

Furthermore, he maintains that:

> "Such cued crying would no more need to denote affective states like those termed unhappiness, distress or despair than would such cued responses as smiles, connote joy, satisfaction or pleasure" (p.45).

Similarly, according to Cairns (1972) attachments of the kind described by Bowlby (1969) and Ainsworth (1969) develop as

> "the presence of the mother begins to assume effective control over the young organism's behaviour patterns through contextual conditioning" (p.222).

Central to this position is the assumption that the child becomes attached to the mother because she satisfies his or her needs. The mother becomes both a discriminative stimulus for reinforcement and a secondary reinforcement stimulus. The child protests upon separation because he or she has learned that the mother's absence is often associated with pain or discomfort, and that crying is effecting in producing the mother's return. Gewirtz (1977) has argued that an important corollary of this position is that when maternal behaviours are no longer contingent on crying resulting from her absence or departure, these cues should lose control over infant crying. Operant crying of this kind, according to Gewirtz (1977) acquires strength when crying results in the infant being picked up, talked to and fed, and diminishes when such crying is ignored. However, he has argued that according to the principle of partial reinforcement, the intensity of separation distress may be greater in the infant who must cry for a long period before the mother responds than in the children whose mother's respond immediately to their signals.

In summary, both attachment and learning theory imply that crying will occur, not only when the infant is hungry or in pain, but also when the infant loses physical contact or proximity with the mother. The major difference between the theories lies in the timing of the emergence of this response. A close reading of attachment theory leads to the prediction that crying upon loss of contact should be evident from birth. The learning theory explanation assumes that the infant must first learn the association between mother's absence and discomfort and that between crying and the mother's return. How rapidly these associations can be learned is not made clear.

1.3 What Precipitates Crying?

Evidence on the events, apart from separation from the mother, which *do* precede and appear to precipitate cries is sparse. Nonetheless, two broad classes of stimuli can be identified from a review of the literature:

(i) internal stimuli such as fatigue, hunger, visceral pain, and illness;
(ii) external physical stimuli including interruption of feeding, painful stimulation, changes in temperature, sudden changes in levels of stimulation, and unfamiliar events and environments.

It should be noted that it is often difficult to ascertain precisely what precipitates crying in young infants, and that a great deal of unexplained fussiness is evident especially during the first three months of life (Emde, Gaensbauer and Harmon, 1976; Illingworth, 1954). It is also important to recognise that while it may be possible to identify stimulating conditions which reliably precede crying, this does not necessarily imply that they did elicit the cry. Furthermore, many of the presumed stimuli, being organic, are not easily amenable to investigation. Although it is generally recognised that the stimuli which precipitate crying are likely to change as the infant matures, there are very few systematic data on age changes.

1.3.1 Organic stimuli

(a) *Hunger*

One of the few systematic attempts to investigate the organic stimuli which provoke crying was undertaken by Wolff in 1969. By comparing the number of babies in a nursery who cried during the half hour before and after a scheduled feeding, he confirmed that hungry babies cry more than satiated ones and when the babies were picked up and held before feeding it quieted them briefly but did not prevent further crying. Wolff (1969) concluded that crying in this situation was not simply a conditioned response to being picked up. Further confirmation of this view was provided by his observation that babies fed by 'propping' a bottle without bodily contact fell asleep during or within 20 minutes of feeding and showed no further crying. In an attempt to determine the relative importance of sucking, swallowing, and gastric distension in soothing crying, hungry infants, Wolff (1969) studied seven infants with congenital tracheo-oesophogeal fistulas. He showed that hungry infants did not stop crying after 15-25 minute periods of sucking when they were not fed by gastrostomy tube, although they did stop when fed by gastrostomy tube without the opportunity to suck. Furthermore, 'sham' feedings given by mouth and simultaneously removed by gastrostomy tube did not arrest crying after the 'meal', while reintroducing the gastric contents through the tube caused the babies to stop crying within 5-10 minutes. Wolff concluded that the rhythmical crying of neonates observed before feeding is probably related to lack of gastric filling rather than to an unsatisfied need for sucking or general oral stimulation.

(b) *Visceral Pain and Illness*

The relationship between visceral pain and crying seems to be obvious, but is extremely difficult to demonstrate. Crying will often stop after the 'colicky' baby has passed gas, spit up or burped (Wolff, 1969), but such observations cannot be readily tested experimentally. Indeed the presence of visceral pain is often inferred from 'unexplained' crying. Interpretations of the causes of colicky crying include gastrointestinal immaturity or inefficiency, urinary tract infection (Du, 1976), allergic reaction to cow's milk (Jakobsson and Lindberg, 1978) and otitis media (Levin, 1975). Stewart, Weiland, Reider, Maugham, Holmes & Ripley (1954), for example, studied 18 five to seven week old infants who cried continuously for 90 minutes at least once a day for three weeks. They found excessive gas in the gastrointestinal tract, more rapid stomach emptying, persistent regurgitation, and increased muscle tension in these babies compared with matched infants exhibiting low levels of crying.

(c) *Fatigue, Need for Stimulation*

Mothers commonly interpret some crying as resulting from fatigue or over-stimulation of the infant. Again it is difficult to confirm this observation empirically, although the inhibition of movement by swaddling does seem to quiet the crying infant or, at least, reduce the general level of arousal (Wolff, 1969). At the other extreme, Gordon and Foss (1965) have argued that some crying results from an unmet need for varied stimulation. Support for this view was derived from their success in reducing the amount of crying in newborn infants by providing systematic periods of rocking when the infants were not crying. Similarly, Pedersen and Ter Vrugt (1973) have argued that the reduction in crying which results from handling and physical contact is evidence for "stimulus hunger" in the young infant.

1.3.2 External physical stimuli

(a) *Temperature*

A clearer pattern emerges when considering the association between infant crying and external physical stimulation. Wolff (1969), for example, tested the extent to which wet or dirty diapers are a sufficient cause for crying. He found that although transient success is achieved on changing infants, "sham changes", in which nurses went through the usual motions of a change in a warmed room but replaced the wet diaper, produced the same reduction in crying as when diapers were actually changed. The lowered skin temperature usually associated with wetness probably accounts for any crying observed. To investigate this possibility, Wolff (1969) compared the total amount of crying in 10 infants when their crib was kept at a temperature of 88-90°F. and when it was lowered to 78°F. He found that babies cried more and slept less at the lower temperature. He suggested that lowered temperatures may have this effect by raising the state of arousal and making infants more responsive to noxious or sudden stimulation. Another common experience of mothers is that many infants cry when they are undressed, and often stop once they are covered. Wolff (1969) found that temperature was not the critical factor in this response since it was observed in summer as well as winter, and in a pre-heated crib as well as in an open bassinette.

(b) *Painful stimulation*

The response of infants to painful physical stimulation is also very obvious, although conventional wisdom has been that very young infants are relatively insensitive to pain. Fisichilli, Karelitz, Fisichilli and Cooper (1974) investigating the course of induced crying during the first year of life, found that infant crying in response to a rubber band flicked on the heel of the foot was relatively depressed at five hours of age, rising to a high and stable level from 2 days to 12 weeks, and declining thereafter. Beyond three months, infants who did not cry were, nonetheless, likely to grimace and struggle to get free. One of the difficulties with the method of stimulation used in the previous study is that it also has a strong element of surprise, and sudden unexpected stimulation, such as loud banging of wooden blocks, is known to provoke crying in young infants (Müller, Hollein and Murry, 1974). This is also an aspect of one of the standard manoeuvres in many newborn assessment procedures (Brazelton, 1973) when support of the infant's head and shoulders is quickly removed in order to produce the Moro reflex. This reliably precipitates crying in most infants.

(c) *Interruption of feeding*

One of the techniques conventionally used to assess newborn irritability is to interrupt feeding (Dunn, 1975; Yang, Zweig, Douthitt and Federman, 1976). In most young infants (less than three months) this is likely to result in crying. Wolff (1969) found that crying in week old infants was most vigorous after the first interruption of feeding, when the baby had taken less than one ounce of formula. By six weeks of age, crying had diminished to 6% of those occasions when a feed was interrupted. It may be that the interruption of sucking is partly responsible for this result, since Yang *et al.* (1976) were reliably able to elicit crying in newborns by removing a rubber nipple on which infants had been sucking. This is consistent with the observation that sucking on a dummy or pacifier is effective in terminating cries and inducing sleep (Wolff, 1969).

(d) *Unfamiliar Stimuli*

As the infant matures, unexpected or unusual configurations of familiar stimuli will provoke crying. Monster masks, contortions of the face or scrambled configurations of facial features will frequently provoke crying in the six month old infant (Wolff, 1969). Equally, the sudden disappearance of a familiar object or toy will often cause infants of this age and sometimes younger to cry (Wolff, 1969).

Although the literature reviewed does enable the identification of stimulating conditions which *may* elicit crying, it does not permit any systematic assessment of the events which typically *do* precede naturally occurring infant cries, nor of the changes in eliciting conditions which take place as the infant matures. In particular, whether infants less than six months old do cry upon loss of contact with or departure of the mother has not been firmly established. Neither is it clear when this response emerges.

1.4 Cry Types

The question of what crying means has also been investigated in terms of whether a given cry pattern conveys information about the infant's state or the circumstances which precipitated the cry. Although it has been assumed in the discussion to date and in much of the literature on crying that the cry is a uniform phenomenon, it is clear that cries vary, not only in duration and the frequency with which they are emitted in a given time period, but also in amplitude and in other acoustic properties such as pitch, phonation, nasality and melody form (Wasz-Hockert, Partenen, Vuorenkoski, Michelsson and Valanne, 1964).

A number of investigators have argued that the acoustic properties of infant cries enable the specification of "cry types", defined by precipitating conditions. In addition, it has been suggested by Bowlby (1958) and others working within an attachment theory framework (Ainsworth *et al.*, 1978) that the cry is a 'sign stimulus' which 'releases' parental behaviour. Basic to this view is the assumption that there are 'cry types', defined by their unique acoustic properties. These cry types are said to convey precise information about the infant's state and to 'release' appropriate parental behaviour. Since the issue of cry types is a contentious one, and because it has implications for the appropriate recording and measurement of cries, it requires further exploration.

Major attempts to differentiate acoustically between cries according to their cause or the underlying infant state have been made by Wolff (1969) and Wasz-Hockert and his colleagues (Wasz-Hockert, Lind, Vuorenkoski, Partenen, and Valanne, 1968). Wolff (1969) distinguished three major cry types on the basis of eliciting events - the hunger cry, the made or angry cry, and the pain cry. However, Wolff's acoustic analysis of these cries was not comprehensive of the range of cry attributes, and it was not until the work of Wasz-Hockert and his colleagues that an exhaustive analysis was made.

In one of a series of studies addressed to the question of cry types Wasz-Hockert *et al.*, (1968) recorded infant vocalisations immediately after birth, following an injection or pinching the infant, within three and a half hours of feeding, as well as when the infant was in a relatively quiescent state. In a series of analyses of the acoustic properties of these sample cries - labelled birth cries, pain cries, hunger cries, and pleasure sounds, respectively - they attempted to determine the acoustic features which discriminated between them.

Results showed that for samples of cries from infants up to one month old, two attributes of the eleven analysed were sufficient to identify cries and assign them to the appropriate category: melody type and length of signal. For older infants - one to seven months - melody form, nasality and shift were found to discriminate between cries. Murray (1979) has argued that since so few of the measures used were predictive and since the major basis for differentiation was length of signal and types of phonation (melody), the Wasz-Hockert results indicate that cries were not uniquely different according to cause but differed mainly in intensity, probably according to the degree of discomfort experienced by the infant.

Two further problems should be mentioned in connection with the Wasz-Hockert studies. In the first place, spectrographic analysis is necessarily restricted to very short samples (2.4 seconds maximum) which break up the overall pattern of the cry. Because the spectrograph provides considerable detail of very short segments of cries, but poor detail of the overall form of a crying episode, much of the research has dealt with very short samples which may not be representative of the important characteristics of the entire episode. This is especially a problem when the basis for selecting samples is non-random and arbitrary as was the case in the Wasz-Hockert *et al.* (1964) study. Furthermore, even if cry types can be specified using spectrographic analysis, the assumed causes of crying have been defined only loosely and it is not clear that the infant's state was truly different in each situation. In addition, Wasz-Hockert and his colleagues have been criticised for the inappropriate inclusion of the pleasure 'cry', which is not usually regarded as a true cry (Müller, Holhien and Murry, 1974).

To overcome some of the problems involved in using brief, restricted samples of cries in the endeavour to identify cry types, Pratt (1981), in one of the few naturalistic studies of cry patterns, made audio and video recordings of 27 infants and their mothers at four weekly intervals. Sound recordings of naturally occurring cries were coded using a cry index computed by multiplying the values of two components, amplitude and density, the latter referring to the amount of time spent crying per unit of time (10 seconds). Using this index Pratt (1981) was able to identify three major cry forms which arose in different contexts. One type began at low values of amplitude and density, then rose gradually to reach maximum values, although this sometimes took up to 20 minutes, especially in older infants. This particular form was seen when the infant was assumed to be hungry or tired, although Pratt produces no firm evidence for this assumption. The second major type appeared to result from sudden stimulation such as a loud noise or the infant falling. These cries started suddenly and at high index values, usually continuing at high levels, although sometimes subsiding to intermediate amplitude and density. The third category of cries seemed to result from situations judged likely to produce anxiety, frustration or annoyance (e.g. a toy being out of reach). Such cries began at intermediate levels and usually continued there with only minor fluctuations. Furthermore, these cries subsided rapidly when an 'appropriate' response was given (e.g. mother handing the toy to the infant), unlike the other cry forms which took longer to cease after intervention. Unfortunately, no clear connection was established between these different cry forms and the precipitating circumstances.

One of the implications of Pratt's work is that each crying episode has a unique pattern of density and amplitude which may be related to precipitating conditions.

Similar recognition of the possible importance of variations in amplitude and density is evident in a number of studies where observers rather than audio recordings have been employed to record cries. In these studies attempts have been made to distinguish fussing and crying, the former referring to unhappy sounding infant vocalisation which is low in intensity, arhythmic and intermittent (Moss, 1974). On the other hand, cries have been defined as any 'distress vocalisation' which is intense, rhythmic and prolonged, accompanied by a characteristic cry grimace and, possibly, tears (Brown and Bakeman, 1975; Moss, 1974). The reliability with which trained observers can make such a distinction has not always been established. In addition, fusses and cries so defined appear to have been treated as if they normally occur as isolated events, whereas the infant typically begins by fussing, building up to a full-blown cry which tapers off again into a fuss (Pratt, 1981). None of these studies has addressed the question of the relationship between precipitating conditions and the resulting pattern of crying.

In conclusion, the question of whether different 'cry' types with unique acoustic properties can be defined by their precipitating conditions remains a contentious one. Most of the studies which have addressed this problem have used only brief samples of cries deliberately elicited by standard stimuli and have not taken account of the overall pattern of the resulting crying episode. Neither have they attempted to sample from the full range of naturally occurring precipitants, but have focussed on a limited selection of likely causes - pain, hunger, frustration and birth. In the one available naturalistic study (Pratt, 1981), the events preceding the identified cry format were not clearly specified. The relationship between precipitating stimuli and the form of the resulting cry pattern remains to be determined.

CHAPTER 2

MOTHERS' RESPONSES TO CRIES

2.1 Why Do Mothers Respond to Crying?

The cry of a young infant is often described as a compelling and urgent stimulus which invites a prompt response. As Murray (1979) has pointed out, it may also provoke intense emotional reactions, ranging from strong feelings of concern to extreme hostility. Likewise, the action taken in response to crying may be nurturant or punitive (Stone, Smith and Murphy, 1973). In extreme cases, prolonged crying may result in physical abuse of the infant (Lamb, 1977).

In a major review of infant crying and subsequent parental behaviour, Murray (1979) has identified two major explanations of why and how parents and other infant caretakers respond to crying. According to attachment theorists, the cry acts as an innate releaser of caregiving behaviour (Ainsworth, 1969; Bowlby, 1969). This is the corollary of the view (Chapter 1) that crying is an adaptive mechanism which evolved to promote close contact with protective caregivers. The genetically programmed crying of infants when they are distressed or out of contact is argued to be adapted to the prototype of the responsive caregiver (Bowlby, 1969). The second major position outlined by Murray (1979) depicts the cry as important in activating emotions, either altruistic or egoistic, which motivate parents and others to respond. In the case of egoistic motivation, parents are said to respond to crying for the same reason they respond to any noxious sound, that is, to reduce aversive stimulation (Gewirtz, 1977; Moss and Robson, 1968). The motivation is said to be egoistic because the parent is motivated to reduce his or her own distress, rather than the baby's. The alternative view, derived from Hoffman's (1975) theory of empathic distress, is that most adults will experience empathic distress on hearing the infant cry, and this will lead them either to act quickly to soothe the crying infant and thus reduce their own discomfort, or to reinterpret the situation to justify inaction.

2.2 The Cry as a Releaser of Caregiving Behaviour

It is often difficult to determine the adaptive significance of behaviour in contemporary human populations since the environments have changed drastically from those in which the behaviour originated. As a result, much of the evidence cited by Bowlby (1969) in support of his thesis concerning the evolutionary adaptiveness of close mother-infant proximity and maternal sensitivity to crying is indirect. It is derived largely from comparative animal studies and studies of contemporary societies which inhabit environments supposed to be comparable to "the environment of evolutionary adaptedness".

Although much of the comparative evidence presented by Bowlby (1969) has been criticized for its heavy reliance on studies of the rhesus monkey (Dolhinow and Olson, 1975), a survey of a wide variety of mammalian species by the ethologist Blurton-Jones (1972) does seem to offer some support for Bowlby's views. Blurton-Jones attempted to determine whether human mothers and infants are innately adapted to remain continuously in close contact by being carried (the pattern common among hunter-gatherer societies and Old World monkeys and apes) or to the relatively discontinuous contact evident in European societies and caching species such as the tree shrew. Caching refers to the practice of leaving the young alone for long periods of time in a hiding place while the mother forages for food. The functional significance of crying is held to be different in each of these two groups.

Blurton-Jones attempted to identify those anatomical, physiological and behavioural features which are typical of the two major rearing patterns of caching and carrying. He then compared these features with those found in human mothers and infants. He concluded that in caching species, several features are evident which are not characteristic of human infants. In the first place, the young remain silent until the mother returns, presumably so they do not attract predators. In addition, cached young do not urinate or defaecate unless stimulated by the mother (Ben-Shaul, 1962a), again so that predators cannot easily locate them. Finally, since they are in the open and not in contact with the mother's body (Dawkins and Hull, 1964), the young possess efficient means of thermoregulation.

The argument that humans are a carrying rather than a caching species is also supported by data, reported by Blurton-Jones (1972) on milk composition, sucking frequency and duration of feeding. Ben-Shaul (1962b), for example found that high protein and fat content is typical of the milk of widely spaced feeders (e.g. rabbits and hares). In contrast, higher primate infants who feed nearly continuously have access to milk which has very low protein and fat content. Human milk is apparently almost identical with that of other apes, and typical of a continuous feeder. Similarly, sucking frequency correlates well with feeding frequency and milk composition. Cached animals which feed infrequently suck the fastest, and fast sucking is associated with higher protein and fat content in the mother's milk (Wolff, 1968). Finally, widely spaced feeders feed for short durations (4 to 5 minutes per day in rabbits) as opposed to the comparatively long periods characteristic of human infants. The slow sucking rate and prolonged feeding of human infants seems, therefore, to be adapted to a pattern of continuous feeding and close contact.

Studies of feeding patterns in hunter-gatherer societies such as the !Kung Bushmen of Botswana (Devore and Konner, 1974; Konner, 1972) also point to a pattern of virtually continuous contact between mother and infant.

Konner (1972) has argued that 98% of the evolution of Homo sapiens took place in a hunter-gatherer economy similar to that characteristic of the !Kung, and that very little evolution has occurred since then. In studying the !Kung, he noted that their infants were carried in a sling on the mother's hip and that feeding was virtually continuous. Infants were nursed at least twice an hour for periods ranging from 30 seconds to 10 minutes. Konner also reported that infants rarely cried, perhaps because mothers could anticipate hunger or distress from subtle cues such as bodily movements and facial expressions. Crying, when it did occur, was treated as an emergency signal and responded to with an average latency of six seconds. Although these observations have been offered as support for the view that human mothers and infants are naturally adapted to close, continuous contact, pre-historians have recently questioned the validity of the assumption that hunter-gatherers such as the !Kung do exhibit patterns of behaviour which are relatively unchanged since "the environment of evolutionary adaptedness" (Shrier, 1980).

Although data from comparative studies and observations of hunter-gatherer societies appear to provide some support for the cry-as-releaser model, the central assumption of this model - that infant crying should lead to prompt and frequent response by the mother - does not seem completely justified.

It is obvious that in contemporary Western cultures mothers typically exhibit considerable delay in responding to cries and a significant proportion of cries are ignored altogether. Bell & Ainsworth (1972), working within an attachment framework, found that mothers of infants up to three months old ignored a median of 46% of crying episodes, with the most responsive ignoring only 4% and the least responsive 97%. Furthermore, mothers delayed in responding to cries for a median of 3.83 minutes per hour, with a range of 2 minutes to 9 minutes per hour.

This finding of considerable initial maternal unresponsiveness, which has been confirmed by other studies (Bernal, 1972; Moss and Robson, 1968) has not been commented on by Bell & Ainsworth (1972) although their own arguments would not lead one to expect this result. Ainsworth *et al.* (1978), in particular, have argued that the responsive caregiver is "a mother who is continuously nearby and responsive to the infant's signals" (p.55) and that this "behavioural system", since it is central to the care and protection of the newborn, should be relatively invariant despite differences in the mothers' social and physical environments.

It is clear that an adequate model of parental response to crying should be able to account for motivational and cognitive influences on patterns of response, since there are obviously wide cultural, historical and individual differences in parental responsiveness to crying.

2.3 The Cry as an Activator of Emotion

The second major group of theories of why mothers respond to cries places more emphasis on motivational and cognitive factors. Murray (1979) has likened infant crying to other biologically significant sound that are graded as opposed to discrete signals. She has pointed out that graded signals increase in intensity with increasing emotionality in the signaler. She (1979) has further proposed that if the infant cry is a graded signal, then its effective reception is "predicted on a modification of the emotional disposition of the listener" (p.204). This emotional disposition is held to be either egoistic or altruistic.

The view that crying is effective in obtaining a response from caretakers because it elicits egoistic motivation has been proposed by a number of researchers within the learning theory tradition (Gewirtz, 1977; Moss & Robson, 1968). Parents are said to respond to crying in order to reduce aversive stimulation. This thesis rests on principles of negative reinforcement as well as on assumptions about the relationship between the quality of the auditory experience (unpleasant) and the physical characteristics of the cry which make it an especially penetrating sound. Ostwald (1963, 1972) has compared the cry to a siren which compresses acoustic energy into a very sensitive region of the auditory spectrum: the fundamental frequency of most cries is approximately 500 Hz. He claims that the infant cry is one of the loudest sounds human beings ever make, having an average level of 83 to 85 dB at 30.5 cm from the mouth. This is approximately 20 dB louder than normal speech and equivalent, according to Ostwald, to the noise of an unmuffled truck. Furthermore, Ostwald (1963) has speculated that the basis for parents' responses is the cry's annoyance value, suggesting that "the listener who cannot escape usually reduces the noise by soothing whatever baby needs occasion it" (p.46).

Although this approach to the mechanisms underlying parental responses to the cry may have some validity, it has been argued (Murray, 1979) that it accounts best for escape from or avoidance of the cry, and less well for approaches to remove the source of distress. An alternative explanation of the motivation to respond to crying is provided by Hoffman's (1975) theory of empathic distress which postulates an altruistic basis for attempts to soothe the crying baby. At the basis of altruism, according to Hoffman (1975) is the response of empathic distress or "the involuntary, forceful experiencing of another person's painful emotional state" (p. 613). He has suggested that the following relationships obtain between altruistic motives and action:

(i) distress cues from another trigger sympathetic responses in the observer;

(ii) the observer's initial tendency is to act;

(iii) the intensity of the experience of distress and the speed of response should increase with the intensity of distress cues from the other;

(iv) if the observer does not act, he or she will continue to experience 'empathic distress' or will reinterpret the situation to justify inaction.

Murray, in relating these features to infant crying, has pointed out that the description of the cry as a noxious stimulus is consistent with the experience of empathic distress as unpleasant. Furthermore, the description of the cry as a compelling stimulus and Pratt's (1981) evidence that cries which are high in amplitude and density result in prompt maternal response fit well with the second and third features described by Hoffman (1975).

In relation to the fourth feature described, it is clear that the observer's interpretation of the general welfare of the distressed person may override the specific cues associated with distress. Thus, the parent whose child rearing philosophy is that one should not spoil the infant by frequently responding to crying, may justify inaction on the grounds that it is important to teach infants that they must not attempt to manipulate their parents. Similarly, ideas about the vulnerability of infants at various ages, may lead parents to be less responsive to the crying of older infants than of younger ones. If, despite these justifications, parents continue to experience distress, they may try to escape from the cry by leaving the child. It may be, as Murray (1979) has argued, that continued exposure to cry sounds and the attendant involuntary distress shifts parents' motivation from altruistic to egoistic, that is, the motivation is no longer to alleviate the infant's distress but to diminish the parents' distress at having to listen to the sound of crying. This is referred to as the "critical toxicity" problem by Tompkins (1963) in his discussion of the emotions aroused when listening to infant cries. He speculated that the emotions aroused must be sufficient to provoke distress in the listener, but not so disturbing as to elicit avoidance of or aggression toward the child. Excessive and prolonged crying may exceed the parents' limits of tolerance for continuing high levels of emotional arousal.

The most obvious difficulty with Hoffman's thesis is that the motivation for action must be interpreted from adults' responses. It is also not obvious that acting to relieve one's own 'empathic distress' by soothing the crying infant is any less egoistic than acting in order to remove an unpleasant source of stimulation. The difficulty of distinguishing altruistic from egoistic motivation is evident in a recent study of parents' responses to infant smiles and cries (Frodi, Lamb, Leavitt and Donovan, 1978). This showed that parents described themselves as feeling "annoyed", "irritated", "distressed" and "disturbed" when watching videotapes of crying infants. The authors interpreted these results as indicating that infant cries are effective in eliciting adult attention partly because adults wish to terminate unpleasant stimuli, although they suggest that the preponderance of descriptions indicating annoyance and irritation may have been provoked by the inability of the observers to terminate the cries. It is difficult to know how the distinction between empathic and egoistic motivation could be made in practice since the predictions for maternal behaviour do not seem to be discriminably different.

2.4 Mothers' Attitudes to the Management of Crying

The literature reviewed in the previous section indicates that the question of why mothers respond to crying is a vexed one which can only be determined indirectly. The 'cry-as-releaser' argument seems to imply that mothers are naturally inclined to maintain close contact with their infants and to be responsive to their infants' cries, particularly those elicited by loss of contact. However, there are only a few contemporary societies in which this pattern is evident and, as already mentioned, one of the major weaknesses of the evolutionary model is that it fails to take account of historical, cross-cultural, and individual differences in how frequently and how promptly mothers respond to crying. Clearly cognitive factors, including those embodied in different child care philosophies, can over-ride whatever pre-programmed tendencies are present.

The model of the cry as an activator of emotions acknowledges and attempts to account for the influences of various ideologies about the socialization of crying on maternal responses to cries. Tompkins (1963) has suggested that most people develop child rearing philosophies which include beliefs about the appropriate management of crying. He has argued that there is a polarization of attitudes such that one is either for or against the child. This polarization is reflected in historical changes in the advice given to parents. The "permissive", child-centred view, is reflected in the statement contained in a recent child-care manual that "the fear of spoiling a baby...is a tragic one" and, further, that "it is the baby who is left awake and crying...who tends to become demanding and difficult" (Leach, 1975, p.210). This view is the antithesis of that represented by child rearing philosophies popular earlier this century. In 1924 U.S. mothers were admonished not to pick up the crying baby between feeds since he would learn "that crying will get him what he wants" and would become a "spoiled, fussy, baby" (U.S. Childrens' Bureau, 1924).

Murray (1979) has argued that these differing attitudes may lead to a polarization of action as well: "either one ignores and, thereby, punishes the child or one tries to soothe the child by removing the source of distress" (p.207). Murray has further suggested that in the latter case, the mother is motivated to action because she experiences sympathetic distress, whereas in the former case the cry is seen as an attempt by the child to manipulate the mother. As a result the mother's response will be influenced by the egoistic emotions of irritation, anger and annoyance. However, whether there is such a relationship between differing child care philosophies and behaviour in response to crying has not been established. Nor has there been any recognition of the possibility that the amount of infant crying might, in fact, determine the ideology and the level of responsiveness. As Murray (1979) has indicated the precise relationships between maternal behaviour, motives and ideologies remain to be determined.

2.5 The Nature and Effectiveness of Maternal Response to Cries

In most of the studies of infant crying reviewed to date, there has been little attention to the nature or the effectiveness of maternal responses to cries and how these attributes are related to the nature of the cry and the circumstances in which it occurs.

Attachment theorists have proposed that an infant's attachment behaviour, including crying, will be "activated" when the mother moves away or disappears from the infant's field of vision (Bowlby, 1969; Ainsworth, 1973). The role of crying is seen as stimulating the mother to come closer to and restore contact with the infant. The clear prediction is that cries elicited by loss of contact with the mother should produce a response which restores that contact and, furthermore, that such responses should be the most effective in terminating cries elicited in this way.

Learning theorists, such as Gewirtz (1977) have also argued that cries will often be occasioned by the mother's departure, although the development of this behaviour has been seen as a function of operant conditioning. According to Gewirtz (1977) mothers of newborn infants will naturally give priority to terminating crying and will respond "conscientiously" to their infants' cries. He has argued that this pattern of consistent response will not only reinforce certain features of crying but will also result in maternal interventions coming under the control of certain "discriminative-stimulus" cues from the baby's appearance and behaviour. He has further suggested that only some maternal responses will provide reinforcement for operant crying. Gewirtz has postulated that, of these, the practice of picking up and holding the infant, is especially likely to be successful in terminating cries, thus reinforcing the cry and, because it succeeds for the mother, positively reinforcing that response. In Gewirtz's view, the occurrence and persistence of cries upon loss of contact and the mother's tendency to respond to such cries will depend on the unique conditioning history of each mother-infant pair.

2.6 The Evidence

In both the relevant empirical literature and in child care manuals, it appears to have been generally assumed that the mother's main aim in responding is to soothe the crying infant, although it is clear that in some circumstances the infant may actually be punished for crying. In the one study where the types of maternal responses to cries were systematically investigated (Bell & Ainsworth, 1972) the coding system employed included only 'nurturant' responses and did not allow for the recording of aversive or punishing reactions by the mother. Although there are clearly some responses, such as hitting, which are likely to exacerbate crying, these have not been investigated, possibly because they are normally infrequent and also because the presence of an observer is likely to inhibit the expression of hostile responses toward the infant. It should be remembered, however, that crying is probably one of the main immediate precipitants of abuse of infants less than 12 months old. Weston (1968), for example, found that excessive crying was given as a reason for battering by 80% of the abusive parents he studied.

There is a considerable literature, often in the form of advice to parents, on the techniques which can be used to quiet the crying infant although their relative success has not always been established (Jolly, 1975; Leach, 1975; Spock, 1957). Nor has there been any systematic research on age changes in the relative efficacy of these techniques. Unless otherwise indicated the techniques described below relate to infants less than three months old. Two general classes of soothing strategy can be identified, namely:

(i) those which have a general inhibitory effect apparently unrelated to the circumstances which precipitated crying, and

(ii) those which are intended to modify or remove the stimulating conditions which appeared to elicit the cry.

2.6.1 Soothing Techniques Unrelated to Precipitating Events

(a) *Sucking*

Wolff (1969) has provided one of the few systematic accounts of soothing techniques which seem to have a general inhibiting effect on crying, regardless of cause. He found that for week old infants, sucking on a pacifier was one of the most effective of these techniques, unless the baby was very highly aroused. Even when babies had gone three to four hours without food, they could be quieted by sucking, even to the point of falling asleep. However, the soothing effect was somewhat unstable and crying resumed if the pacifier was removed. Otherwise disturbing stimuli, suck as tickling, did not appear to provoke arousal when the infant had a pacifier in the mouth, whereas the same stimulus delivered when the pacifier was removed, was likely to arouse the baby and elicit crying. Similarly, babies allowed to suck on the breast will frequently stop crying even if the last feeding was very recent (Bernal, 1972).

(b) *Rhythmical Stimulation*

On the basis of his observations, Wolff (1969) speculated that anything which either reduces the total amount of proprioceptive stimulation or renders the background of exteroceptive or proprioceptive stimulation either constant or rhythmical, will lower the general arousal level, inhibit crying and prepare the baby for sleep or quiet alertness. For example, continuous low level white noise or white light was found to arrest crying and convert a state of high excitation to regular sleep, which was maintained after the stimulus was turned off (Wolff, 1969). Similarly, swaddling was shown to be a very effective method of quieting a fussy baby, providing it was done skilfully and completely inhibited movement (Wolff, 1969).

Rhythmical stimulation such as patting and rocking is also known to be effective in stopping cries. Pederson and Ter Vrugt (1973) found that rocking reduced the amount of crying and suggested that part of this effect was due to the alerting effects of vestibular stimulation. The importance of rhythmical auditory stimulation is indicated by Salk's (1960, 1962) reports that crying newborns can be pacified by the sound of a heartbeat. Despite some doubt over the validity of Salk's findings (Detterman, 1978) because of baseline differences between the experimental and control groups, a considerable body of literature confirms the essential principle of Salk's work, that is, that rhythmical auditory stimulation is soothing to the crying infant (Birns, Blank, Bridger and Escalona, 1965; Brackbill, 1970, 1973). It may be, as Detterman (1978) has suggested, that any stimulus change is pacifying when arousal is high, whereas such change is likely to cause crying when arousal is low. Consistent with this view is Wolff's finding that some stimuli which cause crying in the sleeping infant (e.g. tickling) will also arrest crying. Isolated external stimuli such as a loud whistle or pressure on the abdomen are also transiently successful in terminating crying (Wolff, 1969).

(c) *Approach, Picking Up and Holding*

Picking up and holding the infant has been found to be one of the most effective means of stopping crying. Attachment theorists (Bell & Ainsworth, 1972; Bowlby, 1969) interpret this as evidence for the infant's innate need to maintain proximity to caretakers. Accordingly, they argue that much unexplained crying in infants is precipitated by being out of contact and successfully soothed by regaining that contact. In this case, picking up the infant would be seen as removing the stimulating reactions which precipitated the cry. Equally plausible is Wolff's (1969) suggestion that picking up gives rise to a complex of cutaneous, visual, olfactory and kinaesthetic stimulation which satisfy the young infant's "stimulus hunger". Korner and Grobstein (1966) reported that handling alone was not sufficient to reduce crying, but when infants were held upright against the experimenter's shoulder, they stopped crying, alerted, and scanned the environment on a majority of test trials. The authors attributed this quieting effect to the restraint of the infant's motor activity and the availability of visual stimuli. By two weeks of age many of Wolff and White's (1965) subjects stopped crying and tracked objects which were moved across the visual field. Using this procedure Wolff was able to inhibit a fussy state long enough to induce a state of alert inactivity which persisted even when the moving object was no longer visible. The nature of the stimulus configuration did not seem to be important and the human face had the same effect on crying as inanimate visual objects.

As the infants mature, psychologically significant interventions, as well as the purely physical, become successful in terminating crying. Even at two weeks of age, infants in Wolff's study quieted more readily in response to the human voice as compared with a bell, a rattle or an Audubon bird whistle, even when the voice was of a lower intensity and shorter duration than the other sounds. This effect was consistent by two months of age, when the mere visual presence of a person was also found to inhibit much crying. Bell & Ainsworth (1972) similarly found that the technique of simply talking to or interacting with a crying baby, without coming closer, was effective on 40% of the occasions it was employed. This was clear as early as three months and persisted to the end of the first year. While many of the two month old infants in Wolff's (1969) study cried when a person left the visual field they stopped when he or she returned. This was equally true whether it was the mother or the experimenter. Crying which took place in the mother's absence was also successfully terminated by her return and approach in Bell & Ainsworth's (1972) study, although the effect was more marked at 12 months than at three months of age.

(d) *The Comparative Effectiveness of Soothing Techniques*

While Wolff's investigations do indicate which techniques may be successful in quieting crying infants, they do not allow for an examination of the techniques which mothers normally employ, the usual effectiveness of such techniques, or the situations in which they are employed. In their naturalistic observations of mothers and infants at home, Bell & Ainsworth (1972) identified eight major types of intervention: picks up - holds; vocalizes - interacts; feeds; approaches - touches; offers pacifier - toys; removes noxious stimulus; enters room. The most common response in each three month period up to 12 months, was to pick up and hold the baby (30%). Less frequent, but still fairly common, maternal interventions were to feed (15%), talk to or interact with the baby without touching (17%) and approach, sometimes followed by touching (10%). There was little change in the use of these strategies with the age of the infant. The most effective intervention appeared to be to pick up and hold the baby (80% of occasions used). Feeding was almost equally effective, and the least effective intervention was for the mother merely to talk to or interact with the baby without coming any closer. Toward the end of the first year, responses which decreased the distance between the mother and baby were increasingly effective in terminating crying.

Like Wolff (1969), Bell and Ainsworth, made no systematic attempt to relate the interventions used or their effectiveness to the circumstances which precipitated crying, where these could be identified. Nor was there any clear indication of the length of time for which the various techniques inhibited crying. An intervention was considered effective if the baby remained quiet for at least two minutes, so some techniques may have had only a transient effect. While Bell and Ainsworth did calculate a global measure of maternal effectiveness, it was based on the number of interventions undertaken before the cry was terminated and may equally be regarded as a measure of the infant's consolability.

2.6.2 Soothing Techniques Related to Precipitating Events

There has been little investigation of maternal responses apparently aimed at modifying or removing stimulating conditions which appeared to elicit crying. However, Pratt (1981), in his naturalistic study, did make some attempt to correlate the type of intervention used with the *presumed* causes of crying. He divided maternal responses to crying into three categories:

(i) biological responses, which were attempts to alleviate crying assumed to result from biological causes such as hunger and tiredness, and included feeding or settling the infant for a sleep;

(ii) environmental responses, which included assisting the infant to achieve a goal (e.g. putting a toy within reach) or distracting the infant from crying apparently resulting from maternal prohibition of some activity (e.g. playing with and electric light socket); and

(iii) comfort responses, which were either physical contact or verbal reassurance and were not apparently directed to a specific cause.

Pratt found a decrease with age in the percentage of responses concerned with the infant's biological needs, and a corresponding increase in the percentage of environmental responses. There was no apparent change in the percentage of responses in the comfort category, which remained about 20% of all responses for each age. There was no report of the relative effectiveness of each of these categories of response in terminating the infant's cries. Furthermore, while Pratt claimed that biological responses were directed toward cries having a biological origin and environmental responses toward these precipitated by situations likely to produce frustration or annoyance, no firm evidence is offered for this claim.

In summary, there is little evidence on what mothers naturally do in response to cries and whether the nature and effectiveness of their responses are related in any systematic way to the nature of the cry or the events which precede crying.

CHAPTER 3

THE LONG-TERM RELATIONSHIP BETWEEN THE AMOUNT OF INFANT CRYING AND MATERNAL RESPONSIVENESS TO CRIES

3.1 Introduction

The consensus in the research literature and in child care manuals has been that the amount of infant crying is relatively easily, although often inadvertently, modified by the frequency and promptness of maternal responses to cries (Bell & Ainsworth, 1972; Gewirtz & Boyd, 1977a; Leach, 1975). There has been only cursory acknowledgement of the considerable individual differences in crying and of the possible effects of these differences on maternal behaviour (Moss, 1967). Long-term changes in crying are clearly believed to result from the pattern of maternal response to cries, although the precise effects of these responses have been in dispute. However, there is very little convincing evidence on the long-term relationship between infant crying and mothers' responses to that crying in a form which permits an assessment of the relative contributions of maternal and infant behaviour to any change observed.

3.2 Models of the Long-Term Relationship Between Infant Crying and Maternal Responsiveness

A review of the relevant literature does enable the identification of three distinct approaches to the possible relationship between the amount of infant crying and maternal responsiveness to cries. These are illustrated in Figure 3.1. The first, developed from the work of Bell & Ainsworth (1972), depicts the mother as the driving force in the relationship. It indicates an inverse relationship between maternal responsiveness to cries and the amount of later infant crying; the more frequently and rapidly the mother responds to cries, the less the infant will cry later on. The amount of infant crying is assumed to have little or no effect on the level of maternal responsiveness.

The second approach, illustrated by the work of Moss (1967) and Dunn (1975) gives the infant's behaviour more weight. The amount of crying at one period is shown to determine the mother's responses to cries at a later period, in the direction that high rates of crying will decrease

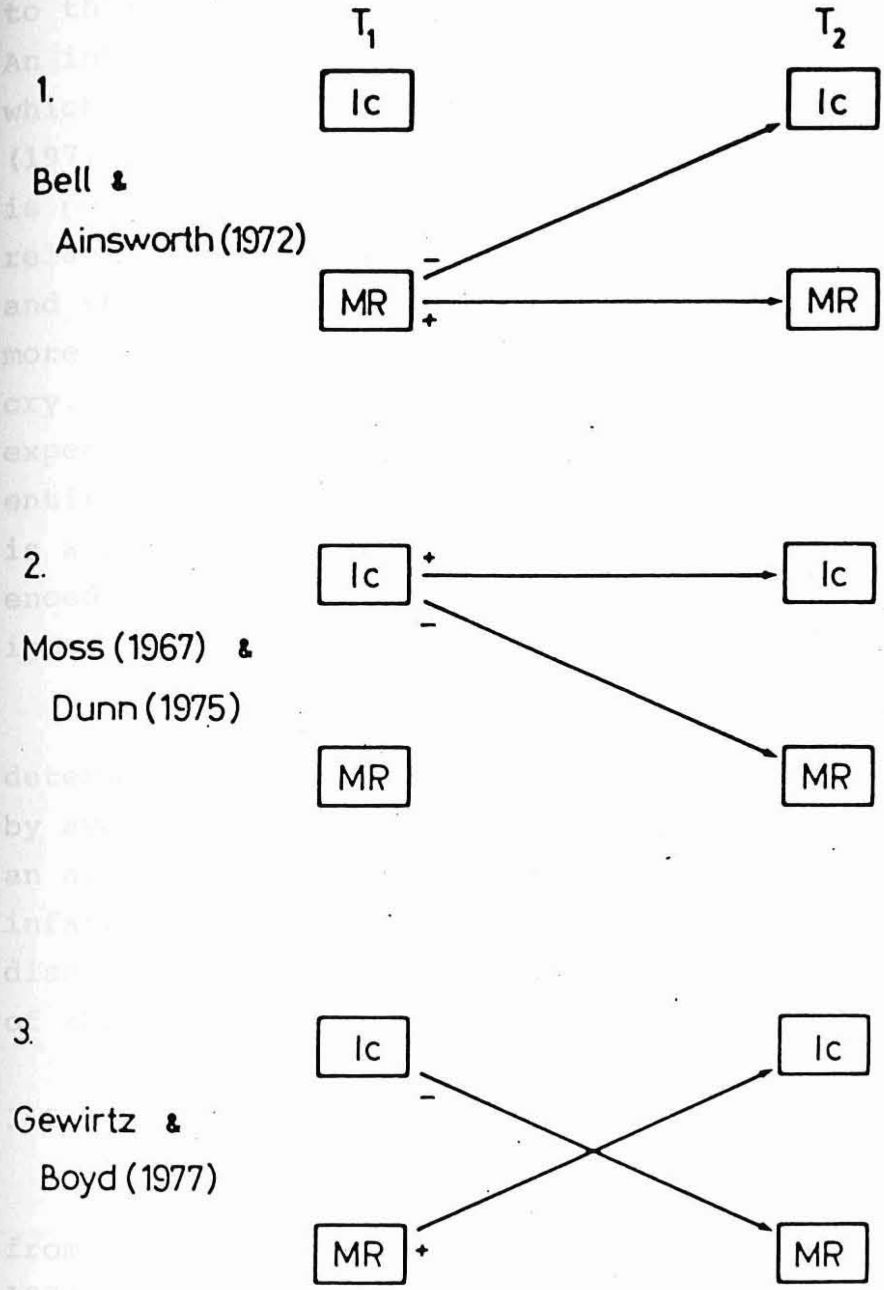

FIGURE 3.1: Illustration of three approaches to the causal relationship between the amount of infant crying (I_c) and maternal responsiveness (M_R) measured at two points in time (T_1, T_2), where + indicates a positive association and - a negative association.

her responsiveness. The mother's responsiveness, according to this view, has little impact on the amount of crying. An intermediate position is represented by the third approach which derives from the work of behaviourists such as Gewirtz (1977). The relationship between crying and responsiveness is portrayed as one of reciprocal influence. However, the relationship between maternal responsiveness at one time and the amount of crying exhibited later is positive; the more the mother responds to cries, the more the infant will cry. The direction in which maternal responsiveness is expected to be modified by the amount of crying is not made entirely clear in Gewirtz's (1977) analysis, although there is a suggestion that high rates of crying will be experienced by the mother as aversive and will lead to her ignoring more cries.

These three approaches are described more fully to determine whether predictions made from them are supported by available evidence. The conditions necessary to enable an assessment of the long-term direction of effects between infant crying and maternal responsiveness to cries are also discussed before specifying in detail the principal aims of this investigation.

3.2.1 Mother influences infant:

The first approach illustrated is based on predictions from attachment theory and results from Bell & Ainsworth's 1972 longitudinal investigation of 26 mothers and their infants observed at home over the first 12 months from birth. Bell & Ainsworth (1972) have argued that crying is an evolutionarily adaptive, pre-programmed response especially likely to be elicited by loss of contact with caretakers. The crying of infants when they are distressed or out of contact is held to be adapted to the prototype of the responsive caregiver, a mother who is responsive not only to crying but to other infant signals as well. The mother who responds reliably and promptly to cries is said to develop the infant's "confidence in his own ability to control what happens to him" (Bell & Ainsworth, 1972, p.1188) and to facilitate the development of other modes of communication, at the same time as decreasing the infant's "readiness to use crying as a signal" (p.1185).

These conclusions were based largely on correlations between the amount of crying and the level of maternal responsiveness to cries determined from naturalistic observations (Bell & Ainsworth, 1972). They were interpreted to mean that individual differences in crying at 12 months of age reflected "the history of maternal responsiveness rather than constitutional differences in infant irritability" (p.1177).

Since this is one of the few studies which has attempted to determine the precise relationship between the amount of infant crying and maternal responsiveness to cries it will be examined in some detail. Mothers and infants were observed at home for 4 hour-long periods at three week intervals. Crying was defined to include all "vocal protests" ranging from "unhappy noises to fusses to full-blown cries" (p.1173). Three measures of crying were used: frequency of crying episodes per waking hour, frequency of crying clusters (defined as a group of crying episodes taking place less than two minutes apart), and duration of crying (combined length of all crying episodes per waking hour). Maternal responsiveness was measured by the number of crying episodes the mother ignored, the duration of maternal unresponsiveness (the length of time the baby cries without obtaining a response), and the effectiveness of the mother in terminating crying (the number of interventions employed before the cry was "properly" terminated, that is, had stopped for more than two minutes). Information obtained in each three month period (first, second, third, and fourth quarters) was combined and measures for each quarter converted to ranks which were then correlated both within and between quarters.

There are several major problems in the design and conduct of this investigation which make its frequently cited findings inconclusive. One of the difficulties lies in the method used to record cries. Observers used record sheets divided into 5-minute intervals and were instructed to pay attention to the 'timing' of episodes of crying, although the description of the procedure leads to the suspicion that the onset and offset of cries was not determined precisely. The authors admit that the participant role expected of the observers made it sometimes impossible to time precisely, necessitating the use of estimates. Furthermore, although joint observations were undertaken for the purpose of reliability checks, the authors did not report whether satisfactory inter-observer agreement was obtained. Although Bell & Ainsworth (1972) took the additional precaution of having six coders ignorant of the research hypotheses code the typed narrative reports of the observations, they again do not report the reliability levels obtained in this way.

More serious are the problems of confounding measures of maternal response with measures of infant crying. This is illustrated in Figure 3.2. Consider the measures of frequency. As Bell and Ainsworth were aware, "the number of episodes which a mother ignores is comprehended in the total number of crying episodes - that is, for a mother to ignore any number of cries, an infant must produce at least that many episodes" (pp. 1175-1176). It should be noted that the simple technique of converting the maternal response measure to a proportion of total infant cries would remove this difficulty.

Bell & Ainsworth (1972), however, explicitly rejected this possibility on the grounds that it would introduce distortion and would not reflect the baby's experience. For example, if a baby cried twice during a session and the mother responded to one of these cries, the measure would be 50%, as it would be if the baby had cried 50 times and the mother had responded to only 25 cries. Bell and Ainsworth considered that these two instances were not psychologically equivalent. However, the only way to determine this fact would be to test it empirically.

In employing frequency measures for maternal response Bell & Ainsworth (1972) were forced to employ rather unorthodox corrections to avoid confounding when correlating the frequency of infant cries and the frequency of maternal response <u>within</u> each quarter. Crying episodes ignored

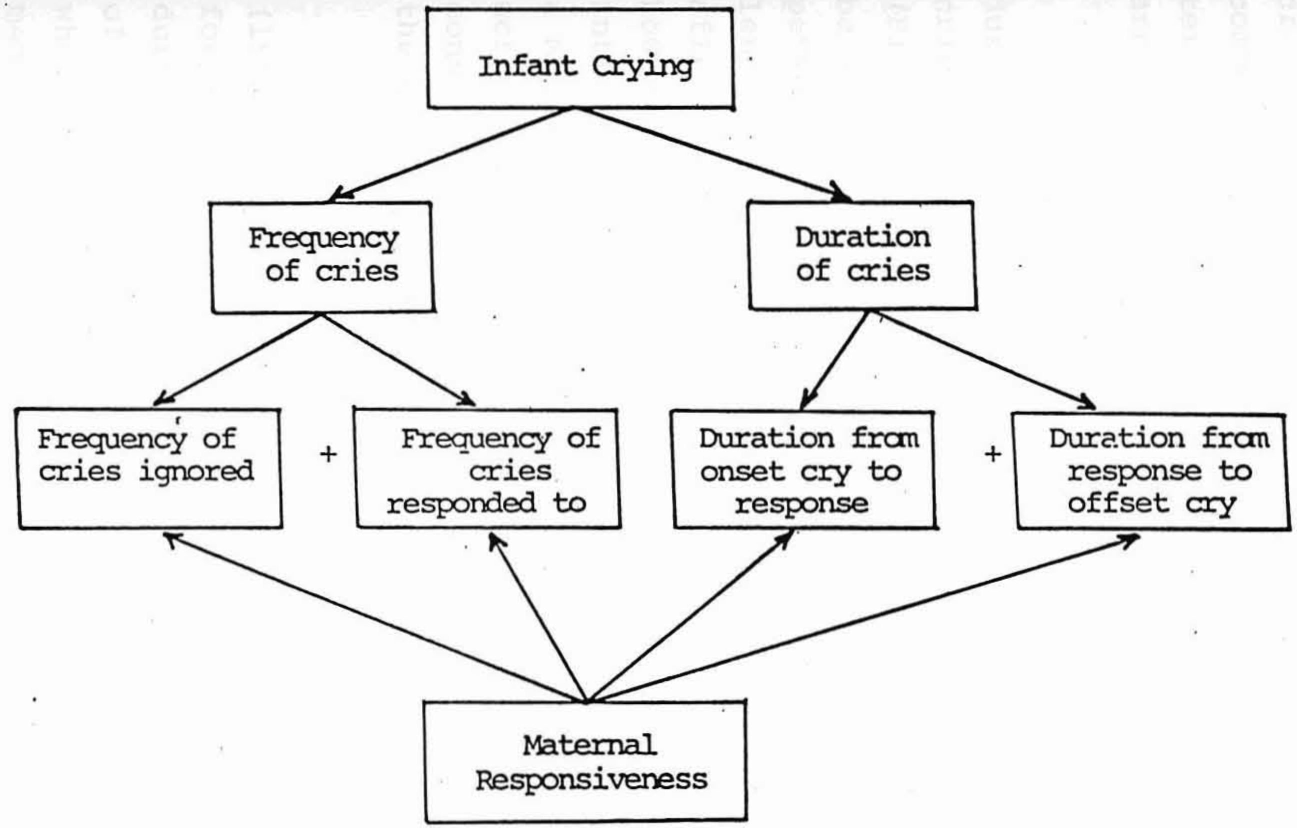

FIGURE 3.2: Measures of Infant Crying and Maternal Responsiveness

were excluded from the infant crying measure. Thus for within quarter comparisons the measure of infant crying was the number of cries to which the mother responded and the measure of maternal unresponsiveness, the number of cries ignored. As a result, the within and between quarter comparisons, central to their interpretation of the long-term direction of effects between these two variables, are derived from different data bases.

Similar confounding problems exist for measures of duration, when the association between duration of infant cries and maternal delay in responding is of concern (Figure 3.2). The infant measure, duration of cry, can be defined as the total time spent crying per observation period or the average cry duration. In either case, the length of time for which the baby cries is likely to be affected by how long the mother delays in responding and how effective she is in terminating cries once she does intervene. This means that duration of crying is not only a measure of infant irritability, but also of the promptness and efficiency of maternal response as well as the consolability of the infant, that is, the ease with which the infant can be quieted.

This problem, also acknowledged by Bell & Ainsworth (1972), resulted in them employing further corrections for within quarter comparisons. The infant measure, duration of cry, was corrected by excluding the length of time it took the mother to respond for those episodes where crying continued until she responded. Their duration measure of maternal unresponsiveness was derived only for cries to which the mother responded, excluding altogether cries which were ignored. As well as resulting in different measures for within and between quarter correlations, this also means that the duration of cries measure was likely to be partly a function of maternal efficiency in terminating cries.

Finally, the index "maternal effectiveness" measured in the Bell and Ainsworth study is, in part, a measure of the ease with which the infant can be quieted. Some infants are notably more difficult to console, no matter who attempts to soothe them (Brazelton, 1973). It probably also depends on the point of the crying episode at which the mother intervenes. For example, if the mother responds promptly to a low intensity fuss, she is likely to be conspicuously more successful than if she delays response until the infant has been crying for a considerable duration at full intensity.

On the basis of within and between quarter correlations of these measures (Table 3.1), Bell & Ainsworth (1972) concluded that maternal ignoring increased the likelihood that a baby would cry more frequently from the fourth month on, whereas the frequency of infant crying had no consistent influence on the number of episodes the mother ignored. Similarly, in relation to the duration measures, they concluded that "mothers who ignore and delay in responding to the crying of an infant when he is tiny have babies who cry more frequently and persistently later on" (p. 1,181).

Both the analysis and interpretation of these data may be criticized on several counts. As already indicated the corrections used mean that the within and between quarter comparisons were derived from different data bases. In addition, in summarizing their conclusions, which have been frequently quoted, Bell and Ainsworth claimed that "consistency and promptness of response is associated with decline in frequency and duration of infant crying" (p. 1,171). However, as Gewirtz & Boyd (1977b) have pointed out, maternal responding is not necessarily the inverse of maternal ignoring. Despite having explicitly avoided using proportions, Bell and Ainsworth treated the variable maternal responding as the inverse of maternal ignoring, as if the frequencies of these two behaviours has been converted to proportions of their sum.

Table 3.1: Tables 3 and 4 from Bell and Ainsworth's 1972 paper on infant crying and maternal responsiveness

Episodes of Crying Ignored by Mother and Frequency of Crying

Frequency of Crying	Episodes Ignored by Mother			
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
First quarter	-.04	.34	.48*	.21
Second quarter	.56**	.35	.32	.29
Third quarter	.21	.39*	.42*	.40*
Fourth quarter	.20	.36	.52**	.45*

* p < .05

** p < .01

Duration of Mothers Unresponsiveness to Crying and Duration of Crying

Duration of Crying	Duration of Mother's Unresponsiveness			
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
First quarter	.19	.37	.12	.41*
Second quarter	.45*	.67**	.51**	.69**
Third quarter	.40*	.42*	.39**	.52**
Fourth quarter	.32	.65**	.51**	.61**

* p < .05

** p < .01

This issue is further complicated by the positive relationship reported between infant crying and maternal ignoring of crying within the third and fourth quarters. The infant crying measure used was modified for within quarter comparisons and was based on only those cries to which the mothers responded. Given this definition, the within quarter correlations are operationally a positive relation between mothers responding to cries (the infant cry measure) and mothers ignoring cries. The more mothers ignored cries the more they responded to them. The correlations reported in the 1972 paper were -.04, .35, .42 and .45 respectively. In replying to the Gewirtz & Boyd (1977b) criticism of their 1972 paper, Ainsworth and Bell reported the co-efficients between the number of crying episodes per hour to which the mother responded and the number of crying episodes per hour which she ignored. There were -.05, 0.36, 0.02 and .01 for each of the four quarters. It is difficult to know how to interpret this discrepancy, since both sets of correlations were apparently derived from the same results.

Further criticism has been directed at the Bell and Ainsworth paper for the absence of control over antecedent and concurrent variables which could have influenced the two sets of dependent variables, infant crying and maternal unresponsiveness (Gewirtz & Boyd, 1977a, 1977b). When total infant crying constituted the dependent variable and earlier quarter maternal ignoring the independent variable, there was no attempt to control for the effects of same quarter ignoring and earlier quarter crying. Similarly, when maternal ignoring was the dependent variable and earlier quarter crying the independent variable, same quarter crying and earlier quarter maternal ignoring were not controlled. As Gewirtz (1977) has suggested, control could have been exercised by separating the two components of the total infant crying variable, namely crying which the mother ignored and crying to which she responded. Furthermore, despite the small number of subjects in the Bell and Ainsworth study, partial or multiple correlation techniques might have been used to provide some degree of statistical control over the variables left uncontrolled. Overall, these criticisms lead to considerable scepticism about the validity of Bell and Ainsworth's conclusions and the model derived from their work.

3.2.2 Infant Influences Mother:

The second approach is based on the results of observational studies by Moss (1967) and Dunn (1975). Moss (1967) studied 30 first-born infants and their mothers over the first three months of life. Infant behaviours coded included fussing and crying, smiling, vocalising and looking at mother, as well as variants of infant state (awake-active; awake-passive; drowsy). For maternal behaviour, codes employed encompassed a range of responses directed toward the infant: holding (close and distant), attending, feeding, burping, rocking, stimulating/arousing, affectionate contact, talking, and smiling. Changes between three weeks and three months in all of these infant and maternal behaviours were analysed. However, in assessing the relationship between maternal and infant behaviour over this time period only global indices of infant state and maternal response were employed. Product-moment correlations relating the infant irritability score (combined fussing and crying) and the amount of maternal contact (holds plus attends minus feeding time) were computed, but only within periods. These showed that maternal contact and infant irritabilit- positively covaried for females at both ages, whereas for males there was no relationship at three weeks and an inverse relationship at three months.

Moss (1967) argued that the correlations he obtained reflect a causal sequence in which the cry instigates maternal action, and that "it seems most plausible that it is the infant's cry which is determining the maternal behaviour" (pp. 28-29). He argued that this thesis held even for the case of the negative correlation obtained for males at three months, when the more irritable infants received less contact from their mothers. His position was that mothers of the more irritable male infants were negatively reinforced for responding and may have learned that they could not be successful in quieting their infants, although there is nothing in his data to indicate that males were more difficult to soothe. In conclusion, he argued that "maternal behaviour naturally tends to be under the control of the stimulus and reinforcing conditions provided by the young infant" (p. 29), although it should be recognised that the data analysis techniques were not sufficiently sophisticated to justify this conclusion.

Several major problems are evident in the design and interpretation of this study. In the first place, Moss used a modified time sampling technique to record the behaviours of interest during eight hour long observation sessions. This technique required the observer to indicate which of several behaviours (including fussing and crying) occurred during each minute of observation time. Since each behaviour could be coded only once, a score of 480 was the maximum which could be obtained for each behaviour. This procedure does not produce an unambiguous unit of measurement. For example, some cries recorded in the one minute intervals may have been very brief, whereas others may have continued for the entire 60 seconds. The infant's modified frequency score would be identical in both cases. Furthermore, occasions when several cries occurred within each interval would be treated as equivalent to those in which only one cry occurred, since each behaviour could be recorded only once in a given interval. Hence, the modified frequency score is neither a measure of frequency nor duration. This issue will be discussed further in the chapter on method (Chapter 4).

In addition, Moss did not specifically measure maternal responsiveness to cries, but simply computed the total amount of maternal contact. This measure, like those discussed in relation to Bell & Ainsworth's (1972) work, is inevitably confounded with measures of the amount of crying. Finally, data on the relationship between indices of infant crying and maternal contact were not analysed in a way which permitted unequivocal conclusions about the direction of effects between these variables. The correlations reported, which were calculated only within each observation period, could either mean that the amount of maternal contact determined the amount of crying or, as Moss (1967) concluded, that the amount of crying determined the amount of contact.

Similar conclusions to Moss's were reached by Dunn (1975), who observed 20 mother-infant pairs over the first seven months of life. Using Bell & Ainsworth's (1972) measures of infant crying and maternal responsiveness, she was unable to detect any stability in maternal responses to crying and reported that maternal responsiveness was affected by the amount of crying the baby had shown at an earlier age. Furthermore, the relationship was a negative one. However, these results, like those of Bell & Ainsworth (1972), must be treated with caution, since the measures of crying and responsiveness were not independent. In addition, Dunn (1975) failed to provide a clear definition of crying or to report reliability estimates for the measures used.

3.2.3 <u>Reciprocal Influence:</u>

The third approach is supported largely by the arguments of Gewirtz (1977) and Gewirtz & Boyd (1977 a,b) derived from an operant interpretation of the modification of crying. The relationship between infant crying and maternal responsiveness is portrayed as one of mutual influence. These authors have suggested that "at the same time a caregiver's behaviour may be conditioning (reinforcing) responses of her infant, the infant's behaviour may be conditioning the caregiver's own responses (Gewirtz & Boyd, 1977a, p. 107). They have argued that responding to "operant" cries will increase the amount of crying, and that ignoring such cries and reinforcing competing responses, such as smiling, will diminish the amount of crying. The expected effects of the amount of infant crying on maternal responsiveness are not clearly specified, although Gewirtz (1977) has suggested that the very irritable or "colicky" babies whose cries are difficult to quiet will fail to provide reinforcement for the mother's responses. Given this "aversive feedback", the initially responsive mother will decrease her rate of responding. Gewirtz (1977) has further argued that if the mother's responses are indiscriminate (not related to features of the infant's cries, appearance or behaviour), then her responses to cries will constitute a "time-independent intermittent schedule or reinforcement of operant-crying episodes" (p. 49). Such reinforcement schedules, according to Gewirtz should generate high crying rates which are relatively resistant to modification.

The likely effects on maternal responsiveness when the rate of infant crying is low and the infant easy to quiet are more complex. Gewirtz (1977) has suggested that in the usual course of events the mother of such a child will respond frequently and promptly to her infant's cries. Furthermore, she will be reinforced for her responses since the infant quiets easily and cries little. However, Gewirtz (1977) has argued that the fact that some classes of cries (e.g. short-low intensity precursors of crying) will be more easily terminated than others (e.g. long, loud cries) means that mothers will be selectively reinforced for responding. As a function of this differential reinforcement, her responses should come under the discriminative-stimulus cues associated with different types of cry: she will continue to respond to the low-intensity precursors of crying and ignore long, loud cries. The result should be a decrease in the frequency of the latter and an overall reduction in the amount of crying. However, Gewirtz also seems to believe that under some (unspecified) conditions a mother may fail to respond discriminatively. Her indiscriminate interventions will thus constitute a partial reinforcement schedule which will actually increase the amount of crying.

This model is difficult to compare directly with the other models mainly because of the different data bases and analysis procedures required. Gewirtz (1977) has argued that the data used by Bell & Ainsworth (1972), although used to refute an operant interpretation, are "remote from the level of precision required by an operant learning account" (p. 43). He has proposed that in order to ascertain the adequacy of an operant interpretation, it should be possible to specify the moment-to-moment relationships between infant cries and maternal responses. In particular, he has argued that any examination of the long-term effects of one or the other should employ a behavioural description and analysis which enables:

(i) the identification of classes of crying which constitute functional units with respect to contingent maternal response (e.g. short duration, low intensity fusses vs. short duration, high intensity cries);

(ii) the specification of reinforcement schedules where these are operative;

(iii) the description of environmental characteristics (including maternal characteristics and behaviour) which are discriminative cues for infant crying; and

(iv) the identification of contingent maternal responses which are reinforcing.

In relation to the Bell and Ainsworth results, Gewirtz has argued that it is conceivable that "mothers who often ignored episodes of crying were maintaining certain classes of their infants' crying through intermittent schedules of reinforcement" (1977, p. 46).

The inference to be made from Gewirtz' interpretation of long-term changes in crying and maternal responses to crying is that analysis of group data contributes little to understanding the mutual processes operating between mother and infant, and that it is necessary to describe each pair's unique conditioning history to make sense of long-term changes. For example, one mother might shape her infant's loud, lengthy cries by ignoring both short, low-intensity precursors of crying (fusses) and short, low-intensity cries. A second mother might shape the short, low-intensity cries of her infant by ignoring both the precursors of crying and lengthy, loud cries while responding rapidly only to short, low-intensity cries. A third mother might foster behaviour incompatible with crying by responding reliably only to short, low-intensity precursors of crying and ignoring all other cries. Overall, the proportion of cries ignored by these mothers might be very similar, but an operant interpretation would predict very different outcomes.

Gewirtz (1977) has offered his own laboratory demonstration of the modification of high rates of crying in two nursery reared infants as evidence for the model he favours (Etzel and Gewirtz, 1967). In this study, extinction of crying was combined with reinforcement of behaviour incompatible with crying (smiling) to decrease the frequency and duration of cries. While this demonstrates that crying can be modified in this way, it does not allow the conclusion that this is the means by which crying is normally modified in the natural environment. Gewirtz & Boyd (1977 (a)) have specifically argued against the use of naturalistic rather than contrived situations to determine this question, on the grounds that

> "interactional phenomena in natural settings have many overlapping facets and can occur in rapid sequence ... (making it) difficult to analyze them in the detail required to demonstrate their relevance or irrelevance to a particular model like that of operant conditioning" (p. 138).

However, Patterson and his colleagues have undertaken just such analyses from their naturalistic observations of aggressive and coercive behaviour among young children (Jones, Reid and Patterson, 1974), indicating that Gewirtz may be unnecessarily conservative on this issue. Furthermore, if crying and maternal responses are usually modified in this way, it should be possible, using appropriately sensitive recording techniques, to address this question in the home environment as well as in the laboratory. If not, it becomes an issue which can never be determined empirically.

In summary, the issue of the reciprocal causal relationships between the amount of infant crying and maternal responsiveness to cries cannot be determined from available evidence. This is partly due to methodological weaknesses in published studies, but also to the lack of agreement about what type of evidence is required for a fair and reasonable assessment of this question. While group data on global indices of crying and responsiveness are apparently considered adequate by Bell & Ainsworth (1972), Dunn (1975), and Moss (1967), the Gewirtz & Boyd (1977a, 1977b) argument necessitates a subject-by-subject analysis of the contingencies operating between maternal and infant behaviours. At the very least, an acceptable test of the question of the long-term relationship between crying and responsiveness should incorporate the collection and analysis of both types of data.

3.3 Conditions Necessary for an Examination of the Causal Relationship between Crying and Responsiveness

Several methodological conditions for both group and individual data must be met before an adequate examination of the question of the reciprocal relationship between crying and responsiveness can be attempted. These are outlined before proceeding to a closer scrutiny of precisely what is required by an operant analysis.

The first requirement is that measures of crying and maternal responses to cries must be independent. Both Moss's (1967) and Dunn's (1975) studies appear to share the problem of confounding these measures. While Bell & Ainsworth (1972) avoided this error, it was at the cost of employing corrections which cast doubt on the validity of their results. Only the measures frequency of crying and proportion of cries to which mothers respond appear to be truly independent.

A second condition is that data on the relationship between these indices be analysed in such a way that conclusions about the direction of effects can be made. Simple correlations computed within time periods (Moss, 1967) do not permit unequivocal conclusions to be drawn. Although between age correlations, like those reported by Bell & Ainswoth (1972) and Dunn (1975) appear less equivocal, they present similar difficulties of interpretation. For example, a negative correlation between the frequency of maternal responses to cries at one period (T_1) and the amount of crying and the next (T_2) could mean that low levels of maternal response increased the amount of crying. Equally it could be that the amount of infant crying was a highly consistent attribute and that a high rate of crying at an earlier time period (T_{-1}) had diminished maternal responsiveness at T_1. In this case the amount of infant crying at T_2 would appear to be influenced by maternal responsiveness at T_1, but this would, in fact, be an indirect effect mediated by the earlier level of infant crying.

To determine the issue of the long-term direction of effects it seems necessary to employ statistical methods which enable an analysis of causal relationships. This entails controlling for or at least specifying the effects of antecedent and concurrent variables which might also influence the variables of interest. For example, when examining the relationship between responsiveness at T_2 and crying at T_3 it is necessary to control for the effects of responsiveness at T_3 and crying at T_2. The construction of causal models, sometimes called structural equation models or path analysis, is one such group of techniques which has proved especially productive in the analysis of econometric data (Jöreskog, 1973) and, more recently, in the analysis of longitudinal data in developmental psychology (Rogosa, 1979). These techniques enable examination of how change in one variable in any system affects other variables in the system, and are essentially a means of decomposing observed associations into direct and indirect effects. Models, generated from theory or empirical findings, can be tested for "goodness of fit" against observed correlations.

An additional requirement necessary to evaluate the Gewirtz & Boyd (1977) argument is that data be collected in a manner which permits the contingencies between crying and maternal response to be determined. To achieve this, it is necessary to use a recording technique which allows for the identification of time of onset and offset of relevant behaviours as well as the patterning of these behaviours. An appropriate form of analysis designed for interactional data should also be employed.

3.4 The Gewirtz-Boyd Approach: Deriving Testable Research Questions

It is difficult to determine from Gewirtz's (1977) arguments precisely what is required for an adequate test of his thesis on operant conditioning of infant crying. Gewirtz espouses a theory of behaviour change which holds that reinforcing stimuli have "response reinforcing" properties and attributes learned behaviour modifications to the contingency existing between a response and reinforcing stimulation. Stated in his own words the reinforcement conception "implies nothing more than that there exist events which, when made contingent on behaviours will change systematically the rates of some of them (that is, of responses)" (Gewirtz, 1977, p.42). An alternative view, not discussed by Gewirtz, holds that reinforcing stimuli have "incentive motivational" properties and attributes learning to the contingency existing between the situational stimuli (not the response in question) and the reinforcing stimulation (Bindra, 1974; Estes, 1972).

As already indicated, the major requirements of the Gewirtz-Boyd approach are the identification of classes of infant crying which constitute functional units with respect to contingent maternal response and the specification of those aspects of maternal response which are reinforcing. Gewirtz has argued that the attributes of latency, duration, intensity and topography may define potential operant classes of infant crying. Using his own example, it is possible that crying of short or long duration may comprise the response class on which reinforcing maternal behaviour is consistently contingent.

The exercise of defining classes of infant crying in terms of these attributes is far more difficult than Gewirtz implies. Take the attribute of duration. The duration of a cry, as indicated earlier, is not an independent measure but is confounded with maternal delay in responding. Moreover, since duration is a continuous variable and does not enable sensible classification on the basis of a dichotomy like "short vs. long", it is not clear how it might be used to define a "class" of cries.

The implication of Gewirtz' argument is that it is reasonable to use maternal delay in responding to define a "class" of cries on the basis of duration. However, it is not clear how this should be accomplished. Is maternal response which occurs after six seconds of crying to the same "class" of cries as one which occurs after 15 seconds? One possible strategy is to determine the average delay of response and use this to characterize groups of cries which act as "functional units" with respect to maternal response. Again, this is problematic because of likely individual differences in the range of delays which make up the average delay score. Incorporating some measure of dispersion would clarify the issue to some extent. For example, the mother whose average delay to response is very short and whose range of response delay is narrow may be argued to be responding to a class of cries loosely defined as having a short duration compared to the mother whose average response delay is similar but whose range of delays is more widely dispersed.

This approach still has problems. The prediction to be made from Gewirtz' position is that mothers who are consistently prompt in responding to cries will selectively shape up short duration cries, so that on subsequent occasions only short duration cries are emitted. However, if the mother continues to respond promptly, there would be no way of determining whether her previous behaviour had, in fact, produced this effect. The conclusion that duration cannot be used to define classes of cries seems inevitable.

Classifying cries on the basis of intensity is less problematic, although still difficult. Intensity, like duration is a continous variable, and seems to covary with rhythm and density (amount of crying per unit time) (Pratt, 1981). A very loud cry is typically rhythmic and dense, while a less intense cry is arrhythmic and intermittent. By using combinations of these variables it is possible to distinguish reliably between cries (high intensity, rhythmic and continous) and fusses (low intensity, arrhythmic and intermittent) (Moss, 1967).

Nonetheless, it should be recognised that fusses and cries rarely occur in isolation. Frequently, a full-blown cry is preceded and followed by fussing without significant interruption. In other cases, the infant may oscillate quite rapidly between fusses and cries before engaging in other behaviours. This is presumably what Gewirtz means by the topography of a cry. Since there is almost inevitably a lag between the onset of any fuss-cry event and maternal response, any analysis of contingencies might reveal spurious associations between maternal response and fusses and cries if the nature of the cry changes during the lag time. Consider the examples shown in Figure 3.3.

If fusses and cries were separately examined for contingent maternal response, it would appear that in sequence (a) the mother had responded to a cry and in sequence (b) that she had responded to a fuss. This indicates that it is important to examine maternal response in terms of the pattern of the fuss-cry event. Of particular significance is the nature of the initial event. Mothers might be expected to be more prompt in responding to a full-blown cry which commences suddenly without the usual intermediate step of fussing than to one which develops gradually from fuss to cry (Wolff, 1969). Similarly, a single isolated instance of fussing might be responded to quite differently from a fuss which rapidly develops into a full-blown cry. Using the initial event and the presence or absence of further fuss-cry

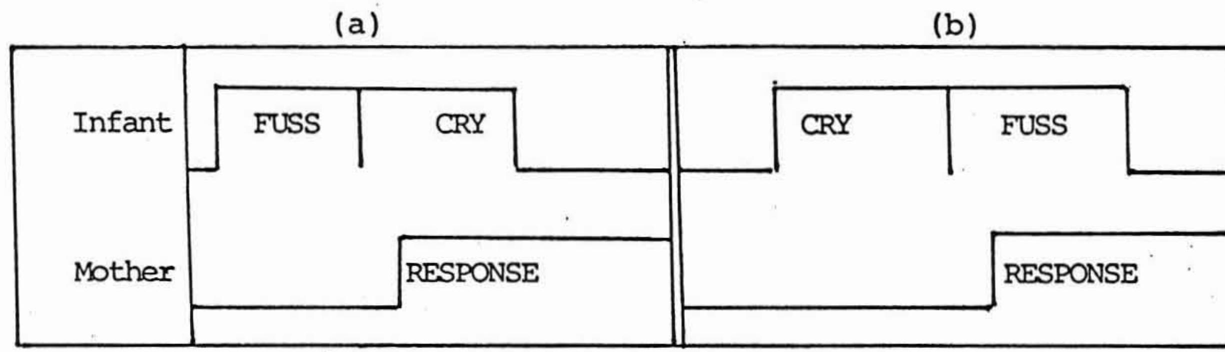

FIGURE 3.3: Illustrative example of two sequences of fussing and crying and contingent maternal response.

events as the defining characteristics, it is possible to reduce the potentially infinite range of fuss-cry patterns to four classes of event which can then be examined with respect to maternal response. These are illustrated in Figure 3.4.

Defining the relevant attributes of maternal response is no less difficult. Gewirtz (1977) has suggested that combinations of latency, duration, intensity, topography and content provide discriminative or reinforcing stimuli to control infant-crying response classes. According to Gewirtz (1977) only certain kinds of contingent maternal responding act as reinforcing stimuli. For example, picking up and holding, b ut not speaking quietly, might reinforce some combination of attributes comprising a crying response class. However, in his analysis of patterns of maternal responding to the infant cry, Gewirtz discussed only schedules of reinforcement and latency to respond, ignoring the question of what constitutes a response. In terms of his operant analysis intermittent and indiscriminate interventions by the mother would effectively constitute a schedule of partial reinforcement likely to result in high rates of infant crying which are relatively resistant to change. Gewirtz also stressed the importance of differential reinforcement of other than crying responses (DRO). To apply a DRO schedule to crying, a caregiver would respond contingently to (reinforce) any response other than crying only after a specific interval of non crying (for example, 30 seconds). Furthermore, if crying occurred, responding would cease until there had been a significant non-crying interval. According to Gewirtz if this schedule were used by a mother, observation would show considerable attention to the baby and little crying by that baby.

An alternative view of behaviour modification is that response-contingent reinforcement is neither necessary nor sufficient for instrumental learning and that such learning can be accounted for in terms of the contingencies operating between reinforcing stimuli and other

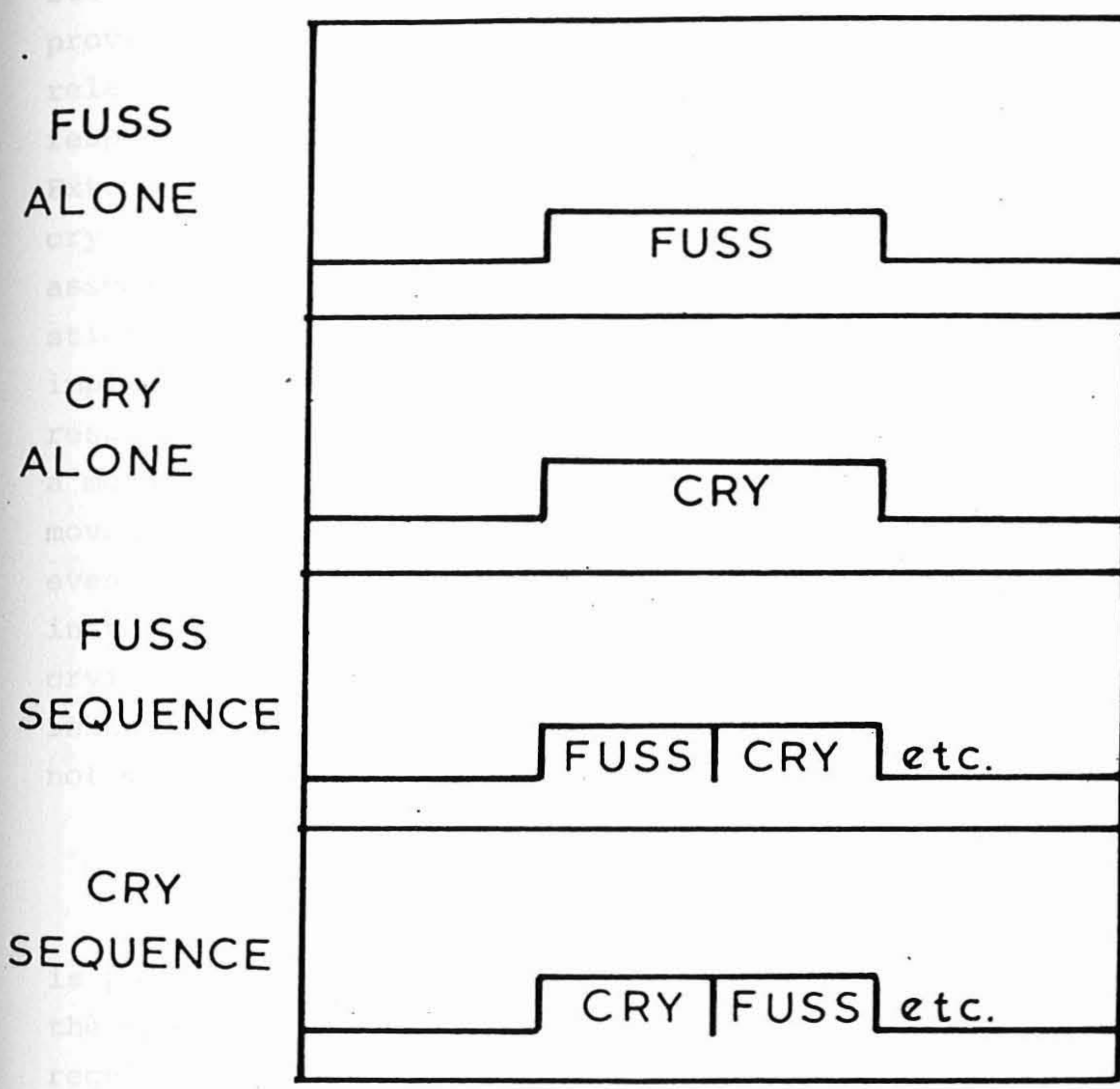

FIGURE 3.4: Four classes of fuss-cry event.

stimuli (Bindra, 1972). Estes (1972) has suggested that reinforcing stimulation does not act backwards to strenghen the response that preceded it "but rather provides an opportunity for the organism to learn a relationship between the stimulus which evoked its response and the 'reinforcing stimulation'" (1972, p. 726). Extrapolating this analysis of conditioning to infant crying, the implication is that the infant learns the association between contingent maternal response and the stimuli which precede or accompany crying. It also implies that regularities may exist between maternal response and these stimulating conditions. For example, a mother might ignore all cries which occur when she moves out of contact and respond to all others. Thus the event, mother departs (S_1), would predict a decrease in the probability of contingent maternal response to crying (S_2). The infant would apparently learn to inhibit the response (crying) in this situation, but not in others.

Despite these difficulties, it is clear that it is possible to derive several tests of the adequacy of the operant analysis. At the simplest level, what is required is to specify reinforcement schedules for each of the classes of fuss-cry event identified earlier and to determine the relationship between various schedules of response and subsequent changes in the proportion of cries in each of these classes. In addition Gewirtz's (1977) argument requires the identification and effects of DRO schedules which might be operating. This can be investigated by determining for selected mother-infant pairs whether maternal responses are contingent on the termination of crying in those instances where cries are ignored and if there are any changes in the amount of crying subsequent to the use of such strategies.

Finally, assessment of the "incentive motivational" interpretation of the modification of crying requires an analysis of whether the relationship between the events which precede crying and the probability of maternal response effects any systematic changes in the events which are later found to precede crying.

3.5 The Relationship Between Crying and Responsiveness and Other Maternal and Infant Behaviours

Whatever the long-term reciprocal effects of the amount of infant crying and the degree of maternal responsiveness to cries, it should be remembered that neither of these attributes exists in isolation and that each may be a component of a more general dimension of behaviour. The possible relationship between these behaviours and others likely to occur during mother-infant interaction is explored further before specifying the major research aims.

3.5.1 Infant Behaviour

Crying is only one of several behaviours which elicit maternal response. Goldberg (1977), among others, has argued that "the infant is equipped with a repertoire of behaviours which effectively capture adult attention and facilitate adult-infant interaction" (p.163). Smiling, vocalizing and eye-contact have all been argued to have special significance in promoting and maintaining mother-infant contact (Ainsworth, 1969; Bowlby, 1969; Clarke-Stewart, 1973; Goldberg, 1977). Both the quantity of these behaviours and their contingency upon maternal behaviour have been shown to be important in determining the quantity and quality of the mother's responses to her infant (Field, 1978; Osofsky and Danzger, 1974). For example, infants who show little alertness and visual attentiveness to the adult's face and voice have been described as "difficult" by both Brazelton examiners (Als' Tronick, Lester & Brazelton, 1977) and the infants' mothers (Field, Dempsey, Hallock and Shuman, 1978).

It may be that the total repertoire of the infant's social behaviours is just as important as the amount of crying in determining the mother's willingness to respond to cries. However, while there is an extensive literature on the characteristics and behaviours of newborn infants, there is very little information on the relationships *between* such characteristics, and virtually nothing on the relationship between crying and other behaviours. It appears to have been assumed that the infant who exhibits a great deal of crying and is difficult to console is also relatively unresponsive to the mother and less likely than less irritable infants to smile, vocalise and look at the mother.

Osofsky and Danzger (1974), in studying the relationships between neonatal characteristics and mother-infant interaction did find a positive correlation between irritability, measured using the Brazelton scale, and the amount of eye contact with the mother during interaction. In a similar study of the patterning of newborn behaviour in an urban population, Osofsky and O'Connell (1977) found that irritability, consolability, lability of state and the amount of motor activity were all inter-related. On reflection it is clear that these measures are not independent. Irritability was measured by the amount of crying during examination and consolability by the number of interventions necessary to quiet the infant. Since the examiner usually proceeds through these in a set sequence, it is inevitable that the infant who cries a lot is less consolable. These measures are invariably highly correlated in the Brazelton assessment.

Similarly, the amount of motor activity is always greater when the infant cries (Korner, Kraemer, Haffner & Thoman, 1974), so infants who cry frequently will obtain high scores on ratings of motor activity.

Relationships between crying and other infant behaviours at later ages have rarely been investigated. In one of the few studies to have addressed this question, Bell & Ainsworth (1972) used a three-point rating scale to assess the stability, clarity and variety of infants' facial expressions, gestures and vocalisations. Using this highly interpretive index they found substantial negative correlations between these aspects of communication and the amount of crying at one year of age. They concluded that infants who cried a great deal lacked other modes of communication, while those who cried little used a variety of more subtle modes which were effective in encouraging and sustaining interaction with the mother These effects were attributed to the mother's earlier responsiveness to crying.

There is also little information on the relationship between newborn irritability and later characteristics and behaviour. In a recent study, however, Fish and Crockenberg (1981) did find that infants judged most irritable on the Brazelton scale at five and ten days of age and who cried the most at one and three months were those who exhibited the most social behaviour at nine months. Social behaviour was defined by the amount of smiling, laughing, vocalising, clinging, and imitation of the mother's behaviour during three-hour long observations in the home. In an earlier paper, (Crockenberg & Smith, 1981) they had reported that up to three months of age babies who took a long time to soothe when crying had mothers who spent more time engaging them in social interactions than mothers of less difficult-to-soothe infants. They observed that the mothers appeared to work hard with their initially difficult-to-console babies, a technique which may have stimulated the infant's subsequent sociability. A similar relationship between irritability and sociability emerged from Kagan's (1971) study. He found that the most irritable girls in a testing situation at four months were also those who were most talkative at 27 months.

The inverse relationship between irritability and sociability has been reported by Bell, Weller and Waldrop (1971) and Shirley (1933). Bell *et. al* found that early irritability, especially in males, was associated with later decreased social interest in peers and adults. Similarly, Shirley (1933) found that greater irritability during anthropometric examinations conducted over the first three years was associated with less social responsiveness to adults.

These studies are difficult to compare since the measures of irritability and social behaviour varied considerably as did the settings and the lengths of time over which the investigations were conducted. The precise relationships between infant crying and other behaviours likely to elicit maternal response remain to be determined.

3.5.2 Maternal Behaviour

Apart from responses typically made to cries, mothers also vary in the proportion of available time they spend in interaction with their infants as well as in the quality of that interaction. The latter attribute is obviously difficult to define with any precision, although a number of studies (Beckwith & Cohen, 1978; Field, 1977; Klaus, Jerauld, Kreger, McAlpine, Steffa & Kennell, 1972) have used the amount of looking, touching, holding and smiling directed toward the infant as an index of the quality of maternal input into interaction. Similarly, the extent to which the mother's responses occur within a given time of an infant's behaviour and are similar in kind to that behaviour, has been used to characterize the quality of maternal behaviour (Field, 1978 and to define a general dimension of 'responsivity'.

Whether the mother's responsiveness to cries is systematically related to these indices of quantity and quality has not been established, although Bell & Ainsworth (1972) claimed that mothers in their study who responded promptly to crying were also similarly responsive to infant signals relating to the onset, termination and pacing of feeding. It is difficult to evaluate this assertion since the data on which it is based were not included in their report. Contrary results were reported by Dunn (1975), who found no close relationships between the promptness of mothers' responses to cries and the amount of affectionate contact (affectionate talk, smiling, and touching) exhibited during interaction with their infants. Nor was there any consistent association between these variables and the mothers' behaviours during feeding.

3.6 Conclusions

Despite an apparently substantial body of research on crying (reviewed in the last three chapters), it is clear that several major questions regarding infant crying and maternal responsiveness remain unanswered. Of central significance is the issue of the long-term, reciprocal causal relationship between these two variables. Despite confident pronouncements in recent child care manuals (e.g. Leach, 1975), the extent to which mothers' responsiveness to cries influences the amount of infant crying has not been established. Nor has the influence of infant crying on mothers' responsiveness been fully explored. In addition, the association between crying and other infant social behaviours has been largely ignored, as has the question of whether responsiveness to cries is part of a more general dimension of maternal responsiveness. Finally, there is little information about the context in which crying normally occurs. With few exceptions the studies reviewed have lacked "ecological validity" (Wohlwill, 1973). As a result the circumstances which naturally precipitate cries, the form of the resulting crying episodes and the nature and effectiveness of mothers' responses to cries remain unclear. The present study is designed to explore all these questions. The specific research aims are outlined below.

3.7 Research Aims

The principal aim of this investigation is:

Aim 1: to examine changes in the amount of infant crying and the level of maternal responsiveness to crying over the first six months from birth and to determine which of the three approaches outlined in Chapter 3 best represents the direction of effects between these two variables.

Determination of this issue requires the analysis of group and individual data, for which subsidiary aims can be specified.

A. Group data

For group data correlations between crying frequency and the proportion of cries to which mothers respond are examined within and between three observational periods: 2 weeks, 3 months and 6 months. These correlations are analysed using the techniques of causal modelling:

Aim 1: to determine the "goodness of fit" of models representing each of the approaches described. Models which provide the best approximation to the data are generated.

B. Individual data

Selected individual data are also analysed:

Aim 1.2: to assess the adequacy of Gewirtz's operant analysis of the modification of infant crying and maternal responsiveness.

As indicated in Section 3.4 this may be reduced to several specific questions:

(i) the proportion of each fuss-cry event (the reinforcement schedule) to which a response is given at one time period;

(ii) any changes in the proportion of cries in each category of fuss-cry event subsequent to the adoption of the reinforcement schedules identified;

(iii) the probability of maternal response being contingent on the termination of crying in those instances where fuss-cry events are ignored;

(iv) any changes in the amount of crying subsequent to the use of such strategies;

(v) the relationship between the events which precede and accompany fuss-cry events and the probability of maternal response; and

(vi) changes in the events which precede cries following from the relationships identified in (v).

C. Other maternal and infant behaviours

The investigation is also designed to enable assessment of:

(i) the relationship between infant crying and other infant behaviours exhibited during interaction with the mother; and

(ii) the association between maternal responsiveness to cries and other maternal behaviours observed during interaction with the infant.

D. The nature of cries and mothers' responses

Finally the investigation allows for the examination of several subsidiary questions regarding the nature of infant cries and maternal responses to cries. These are:

(i) changes in the events which precede and appear to precipitate cries and the relationship between such events and resulting cry patterns;

(ii) the relationships between mothers' beliefs about the appropriate management of crying and their behaviour in response to cries; and

(iii) the nature and effectiveness of maternal responses to cries and the relationship between these attributes and the events which precede crying and the nature of the cry pattern.

CHAPTER 4

METHOD

4.1 Subjects

Eighty two married women expecting their first babies were recruited through prenatal classes and newspaper advertisements. Seven mother-infant pairs were excluded from the final sample because of complications of pregnancy (n = 2); caesarian section deliveries (n = 3) and complications in the newborn infant requiring intensive care (n = 2). Mother-infant pairs were then sampled from the group of mothers initially recruited until a sufficiently large group with an equal number of male and female infants was achieved. The women included in the study ranged in age from 23 to 32 with a median age of 26.1 years. All had completed at least four years of secondary education and could be classified by their own or husband's occupations into professional, managerial or clerical occupational categories (see Appendix 1 for full subject details). All 54 infants (27 males and 27 females) finally studied were normal and full-term, and the mean birth weight was 116.7 ounces (SD 13.9) for males and 114.2 ounces (SD 13.2) for females.

4.2 Data Collection Methods

Three forms of data collection were employed:

(i) questionnaires administered during the final trimester of pregnancy and at the completion of the 6 month observations;

(ii) 24 hour maternal records of infant activity; and

(iii) real time recording of naturally occurring mother-infant interactions. A description of and justification for each of these methods follows.

4.2.1 Questionnaires

Although the methods of recruiting the initial sample of subjects were designed to ensure the sampling of a group of women who were homogeneous in terms of social class, education and preparation for childbirth, it seemed important to establish the extent of any differences in their attitudes towards the pregnancy and birth, as well as examining their child rearing philosophies, particularly in relation to the management of crying. To this end, a questionnaire which consisted of Likert-format items was designed to ascertain

(i) whether or not the pregnancy was planned and accepted;

(ii) any physical or psychological problems experienced during pregnancy;

(iii) plans for and expectations of the delivery;

(iv) preferences about feeding (breast or bottle) and early management of the newborn; and

(v) attitudes towards a number of child rearing issues, including the appropriate management of crying.

This last section is a modified and much reduced version of Cohler's Maternal Attitude Scale (MAS), which has established reliability and has been shown to be useful in distinguishing emotionally disturbed from normal young mothers (Cohler, Weiss and Grunebaum, 1970). A full version of the questionnaire is appended (Appendix 2).

4.2.2 Twenty-four Hour Records

Twenty-four hour records, to be filled out by the mother, were employed so that typical daily patterns of infants' sleeping, waking and crying could be identified. These records were also used to ensure that observations were scheduled to coincide with the period when the infant was most likely to be awake. In addition, it was hoped to provide further information on the amount of infant crying, since the limited sampling of crying obtained in the observation sessions might have produced a distorted picture of the typical behaviour of each infant. The record, based on Bernal's (1972) maternal diary, was designed to be as simple as possible and consisted of a single sheet (Appendix 3) divided into 5 minute intervals and requiring the insertion of simple visual codes to identify the predominant activity in each period - sleeping, feeding, crying, and awake (but not feeding or crying).

4.2.3 Observational Techniques

In any naturalistic study of mother-infant interaction, one of the critical decisions is the manner in which the stream of behaviour is to be sampled. Since one of the aims of the present investigation is to identify the events which precede and terminate cries, it was considered essential to employ a sampling procedure which enabled precise measurement and analysis of both the frequency and duration of various mother and infant behaviours, as well as the relationship between them.

Several types of data may be generated from an observational session, ranging from global ratings requiring considerable interpretation on the part of the observer (Lytton, 1971) through to real time recording of precisely identified behaviours as they actually occur. Sackett (1978) has outlined several common sampling strategies currently employed in observational research, each of which has certain advantages and limitations. Broadly classified they are -

(a) modified frequency recording
(b) event recording
(c) real time recording

An analysis of each of these techniques shows that both modified frequency and event recording produce a seriously distorted picture of any interactional sequence and that real time recording appears to offer the only completely adequate data base for a description and understanding of complex interaction.

(a) *Modified Frequency Recording*

Modified frequency recording is often employed in studies of behaviour modification (Kelly, 1977) but has been used occasionally in developmental research (Moss, 1967; 1974). This procedure requires that the observer makes judgements about the occurrence of a given behaviour at the end of a predetermined period. It generates data on the occurrence or non-occurrence of an event within that period regardless of the number of times such an event actually occurs, and independently of its duration. For example, a 200-sec session might be broken into 20 10-sec modified frequency (MF) intervals, in which case MF scores for each behaviour would be the number of intervals out of 20 in which the behaviour was seen at least once.

In addition to the practical difficulties of using such a strategy (Sanson-Fisher, Poole, Small and Fleming, 1979; Wiggins, 1973), the types of behavioural codes necessarily employed reduce the representativeness of the data obtained. For example, the concept of dominance is often built into such codes, since typically only one behaviour is coded per interval. Observers are instructed to decide which behaviour dominated during the prescribed interval on the basis of either its duration (time dominance) or its significance for the investigation being undertaken (event dominance). As a result, the frequency of occurrence of low priority events is seriously underestimated.

However, as Sackett (1978) has suggested, the major disadvantage concerns ambiguity in the units of measurement. Modified frequency scores are not clearly interpretable in terms of either frequency of occurrence or duration and thus have no true unit of measurement. To illustrate, suppose crying is measured in two children during a 200-sec session divided into 20 10-sec modified frequency intervals. Child A may spend all 200-secs crying earning an MF score of 20, while Child B cries for only 1-sec during each interval and also earns an MF score of 20. In the case of Child A, the score is clearly duration weighted whereas for Child B the score is weighted by frequency. The only occasion when MF methods yield relatively accurate and independent estimates of frequency and duration is when the specified interval is shorter than the mean duration of each of the behaviours to be coded, a situation which rarely occurs.

Furthermore, as Bakeman (1978) and others (Sanson-Fisher *et al*, 1979) point out, the MF technique does not allow for a strict interpretation of the patterning of events. This is illustrated by the interaction sequence depicted in Figure 4.1.

For 7 seconds of the first 10 second interval the infant is observed to be playing alone, after which it begins to cry, continuing for the remainder of the interval. During the same time period the mother watches the baby, but shortly after the baby begins to cry, at 9 seconds, she picks it up and holds it. In the second interval the child continues to cry for a further 2 seconds then quietly attends to the mother for the remainder of the time. The mother, meanwhile, continues to hold the infant. Using a modified frequency procedure with time dominance, the infant's crying will not be recorded at all, and it will seem that the mother interrupts the child's play to pick it up. Similar misinterpretation occurs with event dominance. In this instance, the cry may be considered a significant event and hence be given priority in recording, but the procedure will fail to detect that the infant stops crying in response to the mother's intervention.

(b) *Event Recording*

Similar distortions are introduced when event recording is used. In using this technique, the observer notes the order of events, but ignores their duration. Events are usually defined so that only one can occur at a time (Bakeman, 1978) and typically the observer is required to begin recording only after the onset of a criterion or target behaviour (e.g. crying or smiling) and to sample the codeable events which follow. While this overcomes the MF problem of creating spurious relationships among the coded behaviours, it has the disadvantage that much of the information about the interaction is lost. Not only is the duration of events unknown, but it is also impossible to know which events preceded the onset of the criterion event. In addition, while the sequential dependencies

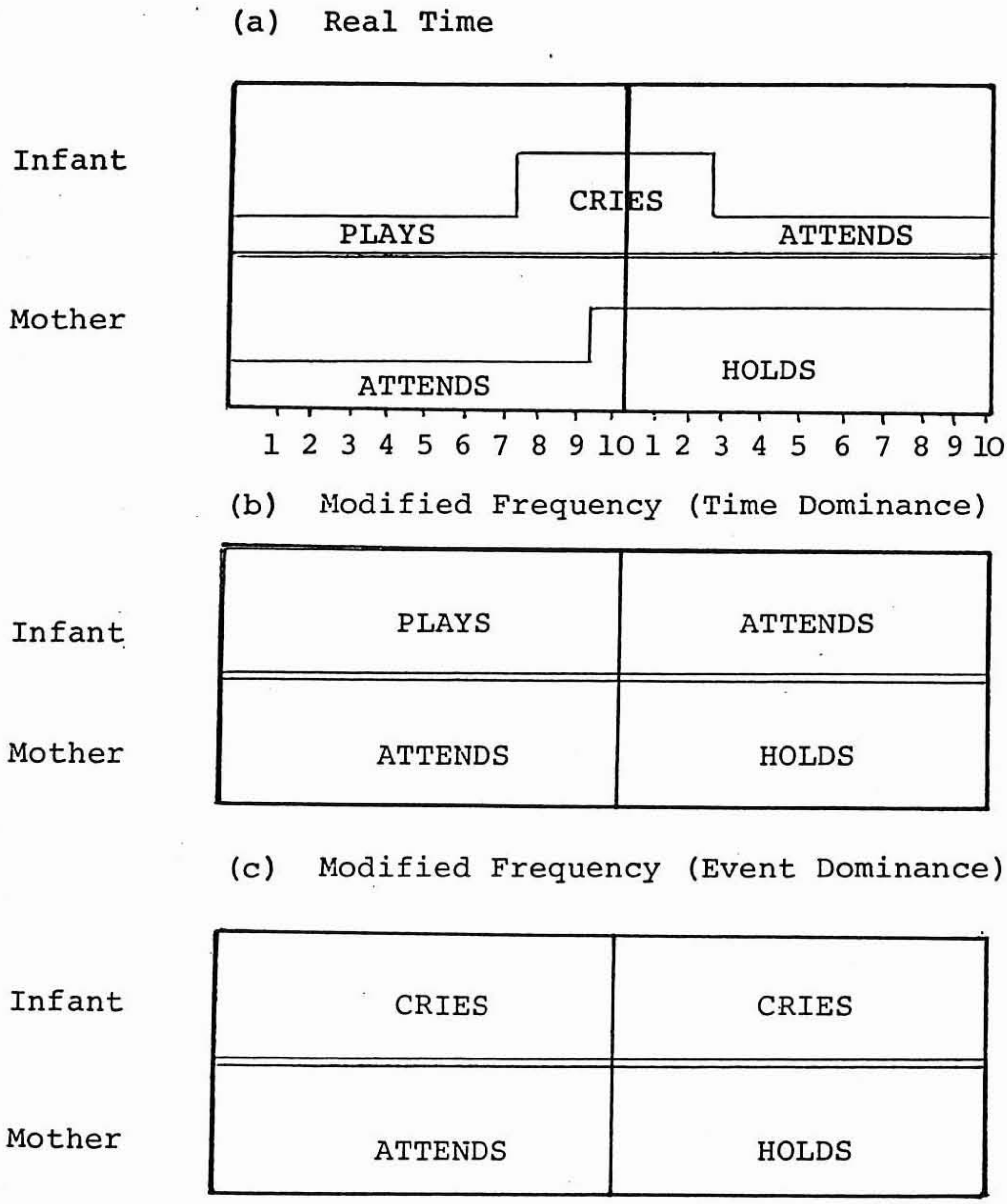

FIGURE 4.1:* Comparison of real time and time and event dominated modified frequency sampling for a typical mother-infant interaction sequence.

*Adapted from Sanson-Fisher, R., Poole, A.D., Small, G. & Fleming, I. Data Acquisition in real time - An improved system for naturalistic observations. Behaviour Therapy, 1979, 10, 543-554.

relevant to the criterion behaviour may be measured, no account is taken of the overall probability of occurrence of the contingent behaviours in the interaction as a whole. For example, an event based sampling strategy may produce the information that maternal vocalisation is the most probable event to follow the infant's cry. However, in order to make sense of this finding, it is necessary to know whether the probability of maternal talk following a cry is significantly greater than the probability that talking occurs at any point in the stream of behaviour. Event recording simply does not produce this information.

(c) *Real Time Recording*

To overcome the problems of both modified frequency and event sampling procedures, real time recording was employed in the present study. Such a technique allows for the precise identification of the onset of every codeable event (frequency) and the elapsed time between onset and offset (duration). More importantly, since the order of codes is accurately preserved, the data are amenable to sequential analysis.

While avoiding the distortion inherent in the MF and event sampling strategies, real time recording is comparatively costly both in terms of the technology required and the degree of training and concentration required of observers to achieve satisfactory levels of reliability. However, these difficulties are not insuperable. Firstly, by extensive training and constant monitoring of observers' performance it is possible to attain adequate inter-observer reliability. Furthermore, the commercial availability of portable electronic coding devices such as Datamyte 900, capable of recording and storing large amounts of field data for direct transfer to the computer, facilities the collection and analysis of interactional data (Torgerson, 1977). A system similar to, but vastly cheaper, than Datamyte (Dart II) has been developed within the Department of Psychiatry and Bheavioural Science in collaboration with the

Department of Biophysics of Sir Charles Gairdner Hospital (Sanson-Fisher *et al*, 1979). This device was used in the present study. A full description of its construction and operation is contained elsewhere (Sanson-Fisher et al,1979)

5.3 Recording Equipment

The Dart II unit, which is portable and battery operated, allows for (a) silence of operation, so that it is relatively unobtrusive in the field setting, (b) comprehensive feedback for observers, (c) storage of data in a solid state memory and (d) rapid transfer via an interface unit to a PDP 11/40 computer. The keyboard is a printed circuit board and each key is a touch sensitive gold-plated contact. To signal that a code is being entered, each key is aprovided with a visual indicator. Dart II permits the recording of 60 discrete codes but it is currently designed to allow entry of data to two separate channels, one channel for recording behaviour of the target subject (infant) and the other for the behaviour of individuals interacting with the target subjects. Within each channel there are 26 discrete behaviour code keys and within the input channel a further 7 keys which may be used to identify the input person whose behaviour is being coded. In total, 208 separate codes may be entered. In this study there is only one input person (the mother) so the additional input channels are used to specify extra maternal behaviours. At present the system permits observation sessions of 7 minutes duration and data may be entered at approximately two events per second, which seems to be below the rate of behaviour change which observers can reliably code. At the end of each 7 minute period, the unit can be rapidly re-set and observation continued without significant loss (3 seconds).

Using available software, the data from each observation session are transferred to computer and written to disk. Each print-out contains the following information:

1. observed person i.e. target or input
2. coded behaviour of the observed person
3. time of onset of each behaviour i.e. time elapsed from the beginning of the observation session to the time of recording that behaviour
4. duration of each behaviour i.e. time from onset of each behaviour until a new behaviour was recorded in the same channel.

Table 4.1 : Data derived from DART II and written to disk

Field

I[a]	II[b]	III[c]	IV[d]
0	2	620	396
1	8	676	16
1	6	692	188
1	20	880	20
1	6	900	184
0	8	1016	32

a Subject code

b Behaviour code

c Time of onset of behaviour, in 0-1 sec units from beginning of rating session

d Duration of behaviour, in 0-1 sec units

A sample of such a print-out is presented in Table 4.1. In field 1; the code 0 refers to the infant and 1 to the mother. Behaviour codes are specified in field 11, 2 being 'cries', 8 'attends', 6 'rocks' and 20 'talks'. In field III the time of initiation of each behaviour is specified, while field IV gives the total duration of each coded behaviour. The data contained in table II are visually represented in Figure 4.2.

4.4 Behaviour Codes

Codes for describing mother and infant behaviours relevant to the research aims were derived initially from

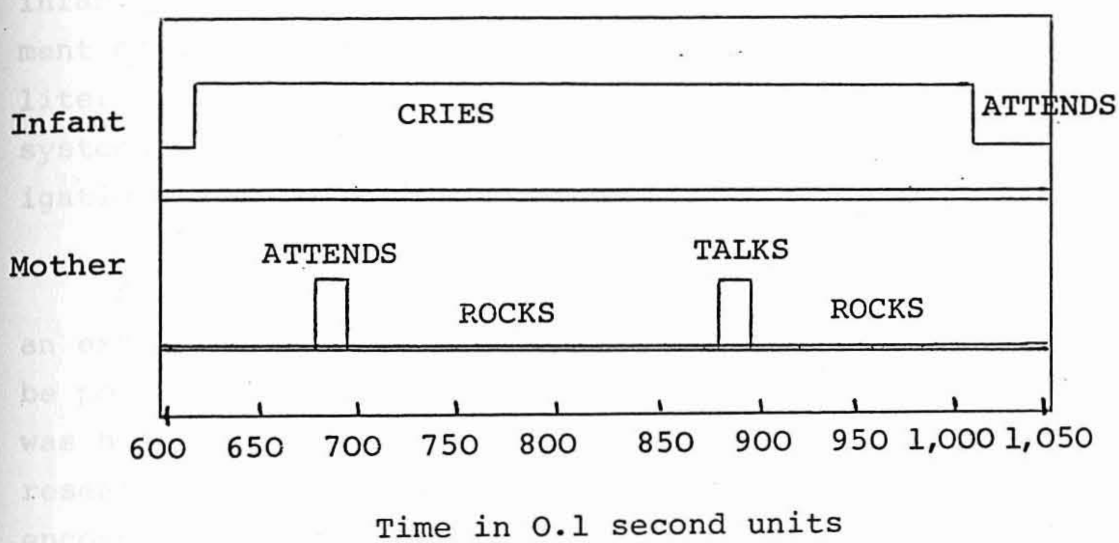

FIGURE 4.2 : Data on mother-infant interaction generated from DART II recording system.

pilot observations of a sample of 10 mother-infant pairs. Particular attention was paid to identifying maternal behaviours which preceded crying (e.g. puts down, moves away, interrupts feed) and those which were consistently involved in soothing the crying infant (e.g. feeds, picks up, rocks, offers dummy). Similarly, an attempt was made to identify infant states and behaviours which preceded crying (e.g. frowns, moves, fusses, falls) or which accompanied or followed crying (e.g. approaches, clings to or climbs on mother). Audio-visual recordings of six mother-infant pairs were also obtained to enable further refinement of the codes. In addition, there is now a substantial literature on mother-infant interactions, and the coding systems of a number of authors conducting similar investigations were examined (notably, Brown & Bakeman, 1975).

Since the data analysis techniques employed require an exhaustive coding system (i.e. some codeable event must be possible at every instant of observation) and since it was hoped to minimise the mother's sensitivity to specific research aims, the behavioural taxonomy was developed to encompass, as far as possible, all infant behaviour and all maternal behaviour directed toward the infant. The level of abstraction reflected in the codes is a compromise between the fine-grained coding possible with video or film recordings of contrived laboratory interactions (Stern, 1974; Trevarthen, 1977) and the global taxonomies employed in behavioural studies of older children (Clarke-Stewart, 1973). The complete coding manual is appended (Appendix 4).

In order to use Sackett's (1979) technique of lag sequential analysis, it was necessary to devise the codes in such a way that the actual occurrence of a given behaviour was faithfully reflected in the data summary, i.e. each behaviour had to be recorded, whether it occured alone or in conjunction with another behaviour. When a hierarchy is built into the coding system, such that certain codes are given priority over others, the occurrence of low priority events will be underestimated.

Because of the considerable capacity of the DART II system, it was possible to minimise this difficulty. One of the input channels was used for the mother's behaviour not accompanied by her looking at the baby, i.e. no attention. For example, mothers often talked to infants across a considerable distance without being able to see the infant. Similarly, during feeding some mothers were simultaneously engaged in other activities, such as reading, and did not look directly at the infant. This would be coded as "feeds" but in the "no attention" channel. A second channel was used to specify the same codes, but with the addition of looking. For example, if the mother looked at the baby while feeding, the "feeds" code would be entered in the "attention" channel. A third channel was used to indicate the simultaneous occurrence of looking and talking during other activities. Hence if the mother both looked at and talked to the baby while feeding, "feeds" would be entered, but in the "attends plus talks" channel. Other concurrent events occurred so infrequently that it was not considered necessary to set aside further channels. In addition, it was felt that further additions would load the memory and decision processes beyond the point where reasonable reliability could be obtained. Babies, fortunately, are less complex and one channel was sufficient to specify all the infant behaviours, the codes being modified slightly at each age period to take account of the expanding repertoire of infant behaviours.

One of the options available with respect to coding crying was to use audio or audiovisual recording techniques. Although such records might have produced more precise indices of the acoustic properties of cries, there were several obvious disadvantages which, it was felt, outweighed the advantages. In the first place, sound spectrographic and other acoustic analyses require a "clean" record, which necessitates recording the cry sound from a fixed distance without significant background noise. During the pilot study, attempts were made to record cries using throat microphones, but the resulting record was so noisy that it precluded sensible analysis.

Both infants' movements and the mothers' talking produced a great deal of interference with the cry sound. In addition, mothers of mobile infants were especially anxious about injury or discomfort to the infant from the long microphone cord. Experimentation with hand held and fixed microphones produced equally unsatisfactory results.

Apart from distracting the observer from coding the ongoing behaviour, both audio and video recorders seemed to increase the mothers' sensitivity to being observed. While the presence of an observer undoubtedly influences the behaviour of those being watched (the problem of reactivity), recent work (White, 1978) indicates that this is a not too great a problem if the observer attempts to be as unobtrusive as possible. The addition of relatively unwieldy portable recording equipment (video or audio) undoubtedly adds to this problem. Indeed, Roberts and Renzaglia (1965) have shown that the larger and more visible the recording equipment, the greater the reactivity. A greater problem is revealed by a more recent study (Kent, O'Leary, Dietz and Diament, 1979) which compared observations made in vivo, via an observation mirror and via closed circuit television. Results of this study showed that the amount of vocalisation was significantly underestimated when video recordings were used.

As a result of these considerations, the decision was made to code crying in the same way as other behaviours, using the DART II equipment. Fussing and crying were separately identified, fussing referring to low-intensity, non-rhythmical nasal or strangulated sounds of varying duration accompanied by a pucker face. Synonyms to aide identification were frets, whimpers and whines. Crying was defined as any intense, rhythmic vocalisation associated with a pucker face and, in some cases, tears. Each was coded as continuous unless more than 3 seconds elapsed between vocalisations.

4.5 Reliability

The assessment of the reliability of observational data necessitates calculation of the extent of agreement between two or more observers about the occurrence or non-occurrence of a given behaviour within a specified time interval or resolution level. In analyzing data recorded with the DART II system it is necessary to select an appropriate resolution level, since the lower limit of this system (0.1 second) is well below that at which trained observers can make decisions about ongoing behaviour. The length of the selected interval has been shown to have an impact on the accuracy of data obtained by modified frequency procedures (Repp, Roberts, Stack, Repp & Barkler, 1976). Sanson-Fisher (1980) has further shown that the 1.0 second interval is the lowest resolution level at which satisfactory inter-observer agreement can be achieved with real time data. Shorter intervals were found to produce unsatisfactory reliability levels, while longer intervals produced underestimates of the frequency of events and overestimates of their duration. For the present study, the 1.0 second resolution level was selected for all data analysis including reliability checks.

In training observers, reliability data, calculated separately for each observation code, were obtained in two ways : (1) from repeated codings by the same observer or randomly selected 7 minute segments of videotaped mother-infant interactions (test-retest reliability), and (2) from simultaneous coding by two observers of selected 7 minute segments of such interaction (inter-observer reliability).

To deal with the problem of observer drift, the coding of each observer was checked each week against carefully coded protocols of one of 5 selected videotaped segments. Reliability during observations was assessed by having two observers code three 5 minute sequences of interaction for 5 different mother-infant pairs at 2 weeks, 3 months and 6 months. Both inter-observer and test-retest reliability were assessed by calculating the coefficient Kappa (Cohen, 1960, 1968), a chance corrected percent agreement measure. Reliability data are reported in Chapter 5.

4.6 Procedure

The women recruited for the study were interviewed during the third trimester of pregnancy to explain the details of the investigation and to administer the questionnaire. To reduce reactivity, they were not told the precise aims of the study, but were invited to take part in a long-term naturalistic study of mother-infant interaction in the home environment. During the interview, procedural details were explained and the women were invited to examine the recording equipment and read the codes to be used during the observations, to reassure them than no judgement of their behaviour was intended. Following this, the questionnaire was administered and the women were given the activity record sheets, together with instructions for their use.

In the week before each scheduled observation the mothers were asked to complete on three alternate days the 24-hour record sheets. They were asked to start recording from midnight and, as far as possible, to fill out the record at the end of each hour, especially if the baby was awake.

4.6.1 Observation Procedures

The observations were undertaken during three two-hour home visits when the infants were 2 weeks, 3 months and 6 months old. Observations were planned to coincide with the period when the activity records showed the infant was most likely to be awake. On the morning of the scheduled observation the mother was telephoned to establish whether tha baby was awake and if necessary, repeated calls were made until such time as the baby was awake. Observations generally took place between 9.00 am and 3.00 pm, at the mother's convenience. No attempt was made to systematically sample different times of day, because of the uncertainty in finding the infant awake and alert.

During observations, mothers were encouraged to do whatever they normally would at that time and to pay as little attention to the observer as possible. The target of all observations was the infant, and mother's behaviours were recorded only when clearly directed toward the infant, although the absence or departure of the mother was systematically noted. The observer, usually standing, took up a position sufficiently close to the infant to enable accurate recording (usually no more than a few feet). If the view became obscured during observation, the observer moved as rapidly and unobtrusively as possible to another location. On occasions, it was necessary to follow mother and infant into another room or into the garden. The observer coded continuously for seven minutes before a flashing light indicated the necessity to stop and re-set the DART II unit. This was completed as rapidly as possible and usually took less than 3 seconds. At the end of 8 such periods (approximately 56 minutes) a ten minute break was taken before observations recommenced. If the baby fell asleep during observation, coding ceased and the sessions were completed when the baby re-awoke, or the session was rescheduled for the following day.

4.7 Analysis of Mother-Infant Interaction: Lag Sequential Analysis

A proliferation of observational studies on parent-infant interaction over the last decade (Schaffer, 1977; Osofsky, 1979) attests to the usefulness of observational techniques, but investigators often fail to take advantage of the unique opportunities such techniques offer. In some cases the data are sampled and recorded in such a way that strict analysis of the patterning of events is not possible (Field, 1979). However, even where the type of data collected allow for such analysis, results are often treated in terms of simple frequencies and durations with no report of the sequence, patterns and repetitive cycles operating within and between participants (Whiten, 1977). In other words, the *interaction* as such is not described.

Since an overwhelming volume of data may be generated from observation sessions, the temptation to reduce the data using the straightforward and familiar indicators of frequency and duration is considerable. However, if certain requirements are met in the construction of behaviour codes and in the recording of data, relatively simple statistical techniques can be applied to reduce the data to meaningful and manageable proportions. Since the research aims outlined require the identification of sequences and patterns of events (the contingencies operating between maternal and infant behaviour), it was necessary to employ a data analysis technique designed for such a purpose. Techniques for analyzing interactional data have burgeoned in the last decade (Sackett, 1978, 1979; Suomi, Lamb and Stephenson, 1979), but they are not particularly standardized or generally available. As a result, the decision to use Sackett's (1979) technique of Lag Sequential Analysis was based largely on the ready availability and apparent simplicity of the technique as well as its suitability for determining the research questions outlined.

Sackett's procedure allows for both the analysis of time and event related patterns as well as providing a simple rationale and procedure for hypothesis testing. Basic to Sackett's (1978, 1979) approach is the concept of the event or time lag. He has outlined several relatively simple steps in the application of the lag techniques: (1) choice of one of the coded behaviours (e.g. crying) as a criterion event; (2) calculation of the frequency with which every other behaviour follows the criterion as (i) the very next event (Lag 1), (ii) the second event (Lag 2) up to (iii) Max. Lag, the longest sequential step of interest. For each criterion investigated, event lags indicate the number of times each instance of the criterion is followed by all other coded behaviours up to the Max. Lag event. Time lags are calculated in the same way, except that data are lagged in successive real time intervals rather than sequences of events.

The choice of time lag procedures requires that the investigator make two decisions prior to conducting the analysis. Firstly, the time unit in which behaviours are to be lagged must be selected so that the unit is sufficiently brief to ensure that one and only one behaviour can occur in that interval. One-second units were chosen for the present study. Secondly, the investigator must decide where to start lagging. Sackett's (1979) procedure allows for 3 possibilities. The first, a level trigger, initiates lagging after every 1-second instance of the criterion. The second method initiates counting at the offset of the criterion event (trailing edge) and the third method uses the onset of the criterion event as the trigger (leading edge), with behaviours being counted at each 1-second lag from this point. Leading edge, trailing edge and event lag procedures were employed on this study.

Once obtained, the lag probabilities are tested for statistical significance against the null hypothesis that the probability of any behaviour following the criterion at any lag is completely random. For event lags, this means that the hypothesis tested is that a particular behaviour precedes or follows the criterion at any lag only in proportion to its occurrence in the data as a whole - its unconditional probability. For time lags the hypothesis is that a behaviour precedes or follows the criterion event in proportion to its occurrence at any randomly selected 1-second instance in the time sequence observed - its proportion of the total test time. The Chi square statistic is then used to test for significant differences between observed (conditional) and expected (unconditional) probabilities

4.8 Analysis of Long-Term Change : Causal Models

Much of the longitudinal research on mother-infant relationships suffers from the deficiency that data are often reported as simple correlations, making it impossible to draw even tentative conclusions about the direction of influence between the behaviour of the mother and her infant. In developmental research, the interest is frequently in determining whether two variables (X and Y) are causally interrelated. There is often a tendency to choose one of two causal hypothesis : X cause Y, or Y causes X. In many situations, it is possible that both hypotheses are partially correct. Central to this investigation is just such an issue : the question of the extent to which infant crying modifies maternal responsiveness and, conversely, the affect of maternal responsiveness on infant crying.

A variety of techniques, variously labelled structural equation models (Jöreskog, 1973), causal models

(Rogosa, 1979) and path analysis (Duncan, 1975) now exist to enable structural analysis of multi-variate time series data such that one can evaluate the extent to which data are consistent with various causal hypotheses. Although these techniques do differ from one another, particularly in basic assumptions and in estimation techniques, they are sufficiently similar to justify discussing them under the general label "causal models".

A causal model is "an explicit and quantitative statement of the postulated causal links between variables of interest" (Rogosa, 1979; p 226). Alternative conceptions of causal relationships suggested by specific theoretical statements are examined with respect to non-experimental data. In the formulation of a causal model, the selected variables in the process of interest are first identified. In the present investigation, the variables frequency of infant crying and proportion of cries to which mothers respond are central. Causal links between identified variables must then be specified, typically from relevant theory and evidence.

Causal models are conceptually similar to regression analysis, although the regression equations which compose a causal model are usually structural regression equations. In structural, as opposed to predictive regression, the interest is in the interrelationships of the theoretically important variables and not simply the predictability of one from the others. As Rogosa (1979) has pointed out, in structural regression, the mechanism which generates the observations can be characterized in terms of more fundamental parameters than is the case with predictive regression. Indeed, as Goldberger (1973) has shown, the coefficients in predictive regression are an amalgum of the structural parameters, such that a change in one structural parameter may change all the predictive regression coefficients. A number of writers (Tukey, (1954); Wold , 1956) have argued that structural parameters have the necessary invariance and stability required for constructing theory and that "any causal theory comes sooner or later to deal with structural regression rather that predictive regression" (Tukey, 1954; p 41).

When a causal model is constructed, the causal links in the model are usually written as structural regression equations, although other approaches are possible (e.g. Kiiveri & Speed, 1981). Estimation of the parameters in the structural regressions, accomplished in a variety of ways depending on the characteristics of the data, then permit an assessment of the causal influences between the specified variables. This is, in essence, a description of how change in any one variable in the set of variables would affect the other variables in that set and provides a means of decomposing observed associations into direct and indirect effects. For example, infant crying at one point in time may be strongly correlated with maternal response at a later observation. This would seem to suggest that crying affects responsiveness. Causal modelling allows the investigator to determine whether this is a direct effect or whether it is mediated by maternal responsiveness at an earlier time period.

It should be noted that causal modelling techniques cannot prove causality. Such procedures, however, may permit the rejection of inadequate theories about causal relations in the light of obtained data. This is of considerable value, and as Duncan (1975) has argued, "the decisive criterion of the utility of a theory is that it can tell us definitively what causal relationships do not obtain" (p 27).

The pictorial representations of the models fitted, called graphs, are mathematical objects with vertices and edges. Each graph is associated with a family of variables with one vertex for each variable: FC_1 FC_2 FC_3, for frequency of crying at 2 weeks, 3 months and 6 months and PR_1 PR_2 and PR_3 for proportion of cries responded to at each of the same periods. The edges indicate the hypothesized causal influences operating between these variables and may be undirected, uni-directional or bi-directional as indicated in Figure 4.3 .

An undirected edge indicates that no causal relationship is assumed. Both uni-directional and bi-directional edges indicate causal influences in the directions specified by the arrows. Thus (b) may be read as "a change in FC_1 produces a change in PR_2" or alternatively that "PR_2 depends on FC_1". This may be represented algebraically as

$$PR_2 = \beta \; FC_1 + \upsilon$$

where the coefficient β indicates by how much FC_1 influences PR_2 and υ, a balancing term to satisfy the equation, is the disturbance or the unexplained variance.

The graph representing all possible causal influences is presented in Figure 4.4 . The formal statistical procedure for assessing the importance of each edge or causal influence in the model is to fit a restricted model with that parameter set to zero, that is, to remove that edge. The difference between full and restricted models is then assessed using a χ^2 statistic to indicate the extent of difference between obtained and estimated co-variance matrices. The structural equations indicate the magnitude of the effects and the residual or unexplained variance.

The particular techniques employed in this investigation were modified and developed by Professor T. Speed and Mr. H. Kiiveri of the Mathematics Department at the University of Western Australia. The reader is referred to Kiiveri and Speed (1981) for a full description and analysis of the approach used here.

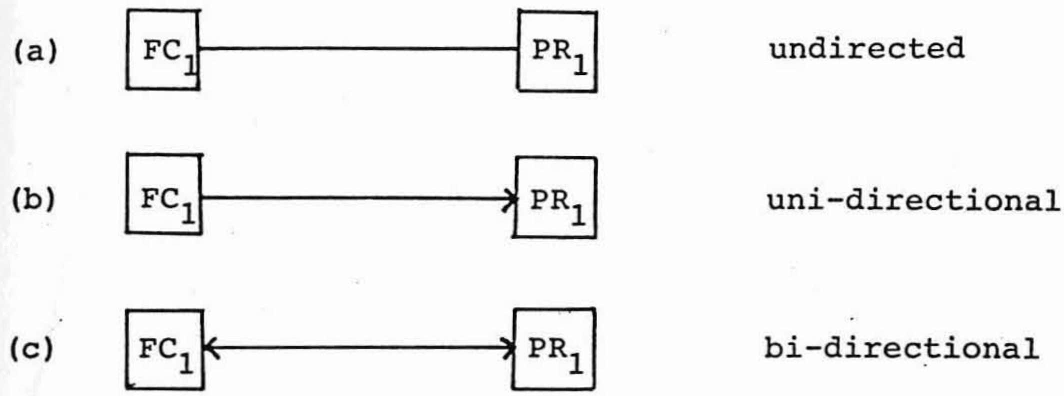

FIGURE 4.3: Graphs for causal models illustrating undirected, uni-directional and bi-directional edges where, FC is the frequency of crying and PR is the proportion of cries to which mothers respond.

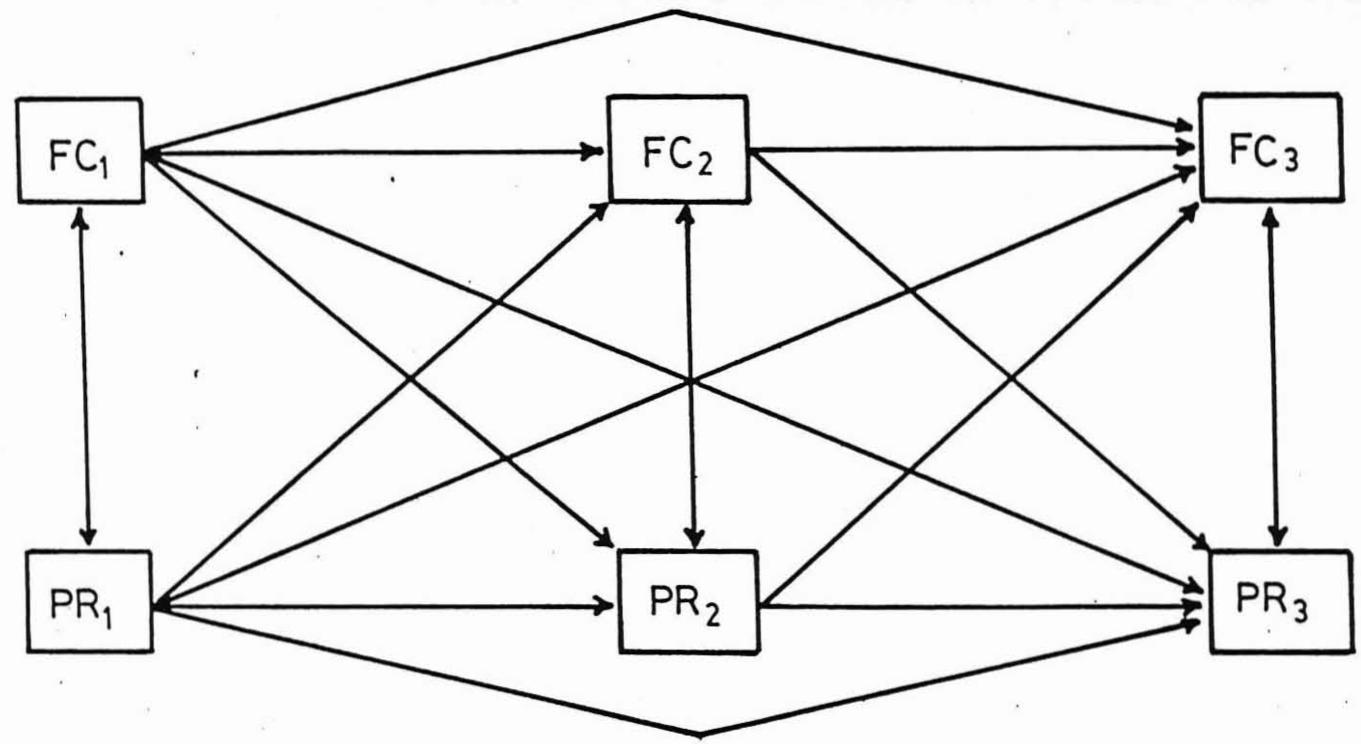

FIGURE 4.4: All possible associations between the frequency of infant crying (FC) and the proportion of cries to which mothers respond (PR) at 2 weeks (1), 3 months (2) and 6 months (3).

CHAPTER 5

RESULTS and DISCUSSION I:

Infant Crying and Social Behaviour

5.1 Introduction

In this chapter results on the amount, daily pattern and antecedents of crying are presented. Data on the quantity and quality of the infant's social behaviour are also described.

The chapter begins with results on the reliability of behaviour codes analysed in this and subsequent chapters. There follows a report of changes with age in the frequency and duration of fusses and cries, and of the total time spent fussing and crying per observation session. These findings are compared with estimates of crying obtained from 24-hour maternal diaries. Data from the same diaries are further used to establish daily patterns of crying for the week preceding each observation session. Although these issues were not included among the research aims, it was considered important to establish whether estimates of the amount and pattern of crying shown by infants in this study differed significantly from those obtained in earlier studies. Individual differences in the amount of crying, including the effects of birth variables, are reported and discussed.

There follows an analysis of the events which precede crying episodes at each age and of the relationship between antecedent events and the form of the resulting crying episode. The chapter concludes with an examination of the relationships among the various measures of fussing and crying and of the associations between measures of crying and those of infant social behaviour (smiling, vocalizing and looking at the mother). For ease of reading statistical details have been kept to a minimum and, where possible, relegated to appendices. In each section, the relevant findings are detailed leaving a general discussion of the major findings and their implications until the second part of the chapter.

A: Results

5.2 Reliability

Prior to the commencement of the observations, two observers were trained until satisfactory levels of inter-observer and test-retest reliability were obtained for all codes. For each code reliability was deemed satisfactory if the Kappa coefficient was significant at the .05 level or beyond. During the investigation inter-observer agreement was assessed by having the two trained observers independently code the same five minute interaction sequences on 45 occasions. Kappa coefficients derived from these observations for behaviour codes analyzed in this chapter and in Chapters 6 and 7 are given in Table 5.1.

5.3 Frequency of Fusses and Cries

It should be noted that both fusses and cries were defined in such a way that if more than three seconds of silence or another infant behaviour followed any instance of fussing or crying, it was considered to be terminated, and any further fussing or crying was treated as a new instance and coded accordingly. If less than three seconds elapsed and no further behaviours intervened between two fusses or cries, they were coded as continuous. The interval of three seconds was chosen since it appeared to be the maximum time necessary for observers to make a decision about ongoing behaviour and change to an appropriate coding category.

Table 5.2 shows the mean number of fusses and cries recorded in each two hour observation session for both male and female infants at two weeks, three months and six months of age. While there was no apparent change with age in the number of fusses, there was a

TABLE 5.1: Kappa coefficients and significance levels for codes reported in Chapters 5 , 6 and 7 (1.0 second resolution level)

Behaviour Code	Kappa Coefficient	Behaviour Code	Kappa Coefficient
<u>Infant Behaviours</u>		<u>Maternal Behaviours</u>	
Fusses	.79***	Feeds	.82***
Cries	.83***	Adjusts/stimulates feed	.78***
Moves	.59*	Interrupts feed	.71**
Avoids feed	.74***	Rocks	.86***
Frowns	.52*	Walks	.89***
Crash	.81***	Adjusts hold	.72**
Smiles	.62**	Affectionate physical contact	.83***
Vocalizes	.71**	Offer toy/objects	.87***
Attends mother	.64**	Plays/entertains	.76***
		Approaches	.70**
		Picks up	.89***
		Puts down	.83***
		Restrains/prohibits	.67**
		General caretaking	.69**
		Moves away	.83***
		Smiles/laughs	.86***
		Talks	.68**

* p < .05
** p < .01
*** < .001

clear decline in the number of cries between three and six months of age.

Separate two-way analyses of variance (sex x age) confirm the age effect for crying ($F = 66.403$; $df = 2,104$; $p < 0.001$), but not for fussing ($F = 1.035$; $df = 2,104$; $p > 0.05$). The percentage of recorded infant events represented by the combined frequencies of fussing and crying (Figure 5.1) further substantiates the finding of a decline with age. Since the number of recorded infant events increased with the age of the infant, the proportion taken up with fussing and crying declined more sharply than the means in Table 5.2 suggest.

TABLE 5.2: The mean number of fusses and cries for male and female infants at two weeks, three months and six months of age.

	Males	Females	Total
2 weeks			
$\bar{X}$ No. of Fusses	12.56	14.37	13.46
$\bar{X}$ No. of Cries	27.48	25.56	26.52
3 months			
$\bar{X}$ No. of Fusses	12.78	15.15	13.96
$\bar{X}$ No. of Cries	25.70	22.07	23.89
6 months			
$\bar{X}$ No. of Fusses	14.04	15.07	14.56
$\bar{X}$ No. of Cries	18.00	13.04	15.54

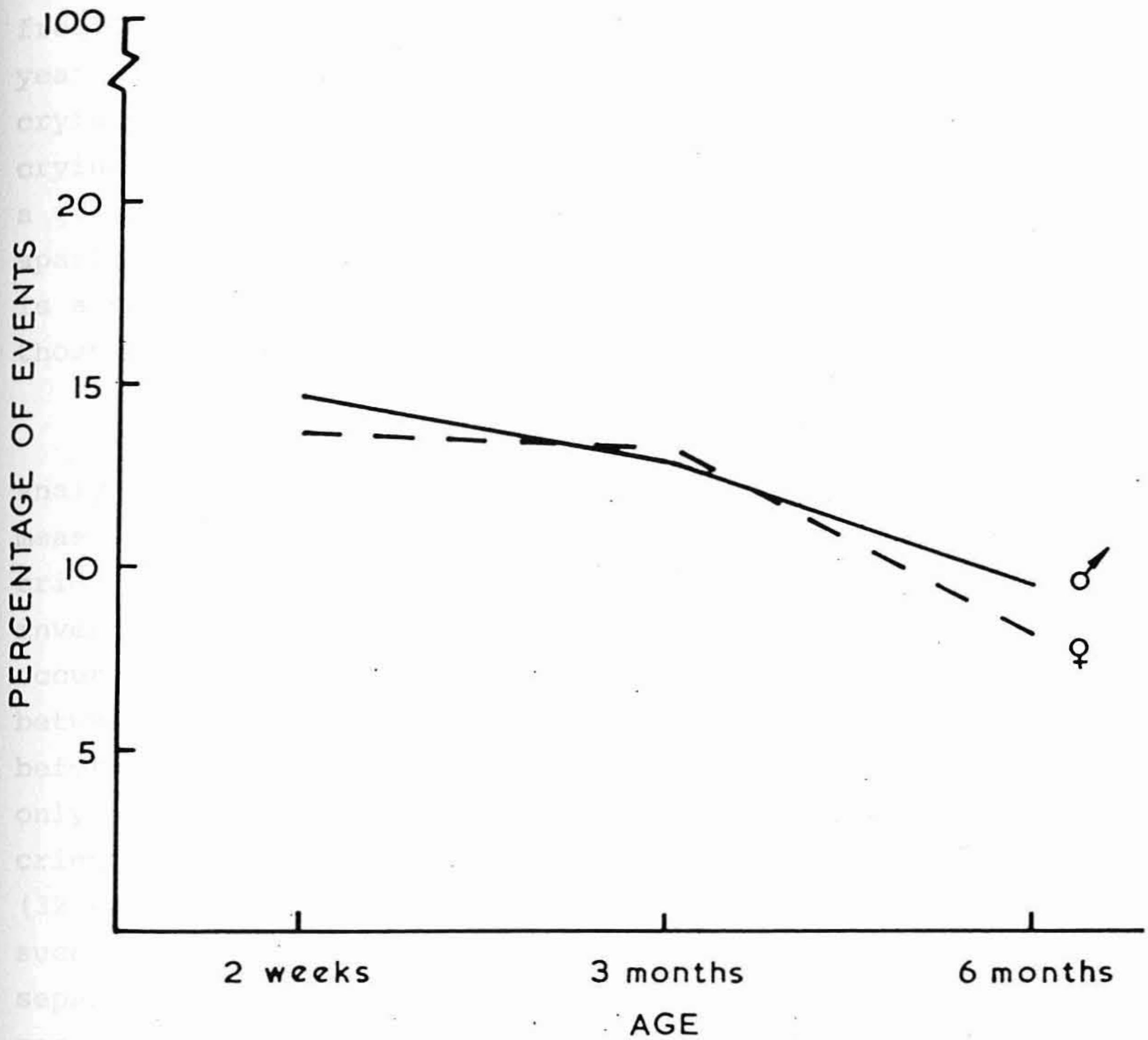

FIGURE 5.1: Percentage of recorded infant events represented by fussing and crying for males and females at two weeks, three months and six months.

The only comparable data in the research literature are those reported by Bell and Ainsworth (1972), who found no decline in the frequency of cries from three months to 12 months of age, reporting a median frequency of 4.4 episodes per hour throughout the first year. However, they do not make clear whether the crying episodes reported refer to separate instances of crying or to "crying clusters", which they defined as a group of cries taking place less than two minutes apart. If the former measure is intended, then there is a considerable discrepancy between their results and those reported here.

The data on frequency of fusses and cries were analyzed to enable comparison with Bell and Ainsworth's measure of "crying clusters". Although both fusses and cries were separately defined and recorded in the present investigation, it is important to note that they rarely occur as isolated events. Indeed infants may alternate between fusses and cries for extended periods of time before engaging in other behaviour. In the present study only 11.7% of fusses occurred as events isolated from cries with the remainder either immediately preceding (32.4%), following (21.6%), or occurring between (34.3%) successive cries. Similarly, only 4.7% of cries occurred separately from fussing. By examining the behavioural records it was possible to determine the frequency of these "cry sequences". A new sequence was considered to have occurred if at least one other infant behaviour was recorded between any instances of fussing and crying. Consider the sequence: fuss, cry, fuss, attend, vocalize, fuss, attend, fuss, cry. Three crying sequences would be identified although there are four separate instances of fussing and three of crying.

When this measure is expressed as an hourly rate, discrepancies with the Bell and Ainsworth findings are lessened (Table 5.3), although they are still substantial and there is still a statistically significant age effect ($F = 6.93$; $df = 2,104$; $p < .01$), with fewer crying sequences as the infants matured.

TABLE 5.3: The mean number of cry sequences per hour for males and females at two weeks, three months and six months of age.

2 weeks		3 months		6 months	
Males	Females	Males	Females	Males	Females
12.7	12.3	10.4	10.6	7.3	6.5

No sex differences in the frequency of fussing or crying or of crying sequences were evident in this sample, nor was there any interaction between sex and age. (Full ANOVA tables for all measures of frequency are given in Appendix 5).

5 .4 Duration of Fusses and Cries

The mean durations of fusses and cries for each observation session are presented in Table 5.4.

As with frequency measures, there was a decline with age in the mean duration of cries, but not fusses. Two-way analyses of variance (sex x age with repeated measures) for fussing and crying confirm this impression. While there was a significant age effect for cries ($F = 7.699$; $df = 2,104$; $p < 0.01$), there was no such effect for fusses ($F = 1.980$; $df = 2,104$; $p > 0.05$). There was also a decline with age in the total time spent fussing and crying (Figure 5.2).

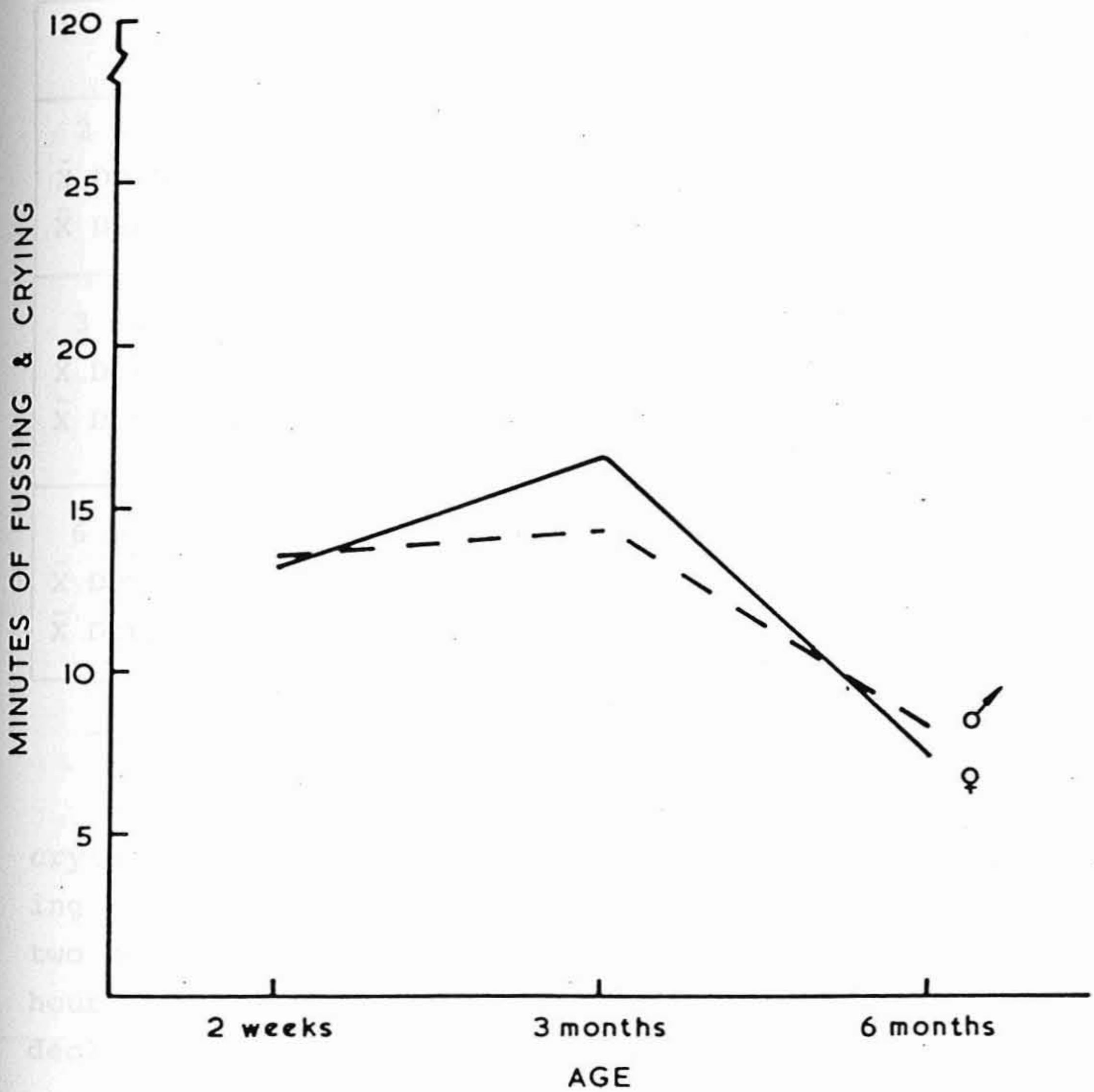

FIGURE 5.2: Mean durations of combined fussing and crying for males and females at two weeks, three months and six months of age.

TABLE 5.4: The mean duration in seconds of fusses and cries for males and females at two weeks, three months and six months of age.

	Males	Females	Total
2 weeks			
$\bar{X}$ Duration Fusses	4.27	4.55	4.51
$\bar{X}$ Duration Cries	29.03	27.46	28.25
3 months			
$\bar{X}$ Duration Fusses	4.56	5.18	4.87
$\bar{X}$ Duration Cries	35.80	35.07	35.43
6 months			
$\bar{X}$ Duration Fusses	4.68	5.03	4.86
$\bar{X}$ Duration Cries	32.30	22.64	27.47

Combining the total duration of fussing and crying recorded in each observation session and converting them to hourly rates gave comparable estimates at two weeks and three months (7.75 and 7.62 minutes per hour respectively), but there was a considerable decline at six months to 4.15 minutes per hour.

Data collected from 24-hour maternal diaries substantiated the observational data. There was again a clear decline in the amount of crying, and similar estimates of hourly crying when compared with observational records: 8.4, 7.9 and 6.6 minutes at two weeks, three months and six months respectively. Since mothers completing the diaries were not required to make a distinction between fussing and crying, hourly estimates of fussing and crying derived from observational records were combined to enable direct comparison with hourly estimates of crying derived from the diaries. Three-way analysis of variance (sex x type of record x age) confirmed the age effect ($F = 24.62$; $df = 2,104$; $p < 0.01$) but showed no effect due to the type of record ($F = 1.64$; $df = 2,104$; $p > .05$) or sex. There was, however, a record x age interaction ($F = 6.59$; $df = 2,104$; $p < .01$) apparently due to a discrepancy between observations and maternal diaries at six months. ANOVA Tables on measures of duration are given in Appendix 5 .

5.5 Daily Patterns of Crying

Daily patterns of crying determined from the maternal diaries are illustrated in Figure 5.3. At two weeks, a peak of crying was reached between 6 p.m. and midnight. Although this diminished with age, there was still more crying in the afternoons and evenings than at other times of the day at both three and six months. There was no increase in crying at times of the day which are often regarded as scheduled feeding times (Rebelsky and Black, 1972), since feeds were typically not scheduled at specific times of day. However there was a clear relationship between feeding and crying not evident from examination of daily patterns. Figure 5.4 shows for each age period the probability of infants being fed after ten minutes of crying as a function of time since the last feed. These results suggest that mothers at two weeks were likely to feed in response to prolonged crying by the infant particularly if three hours had elapsed since the last feed. Even after two hours, approximately half the cries which persisted for longer than ten minutes were followed by a feed. At three and six months feeding was not a highly probable

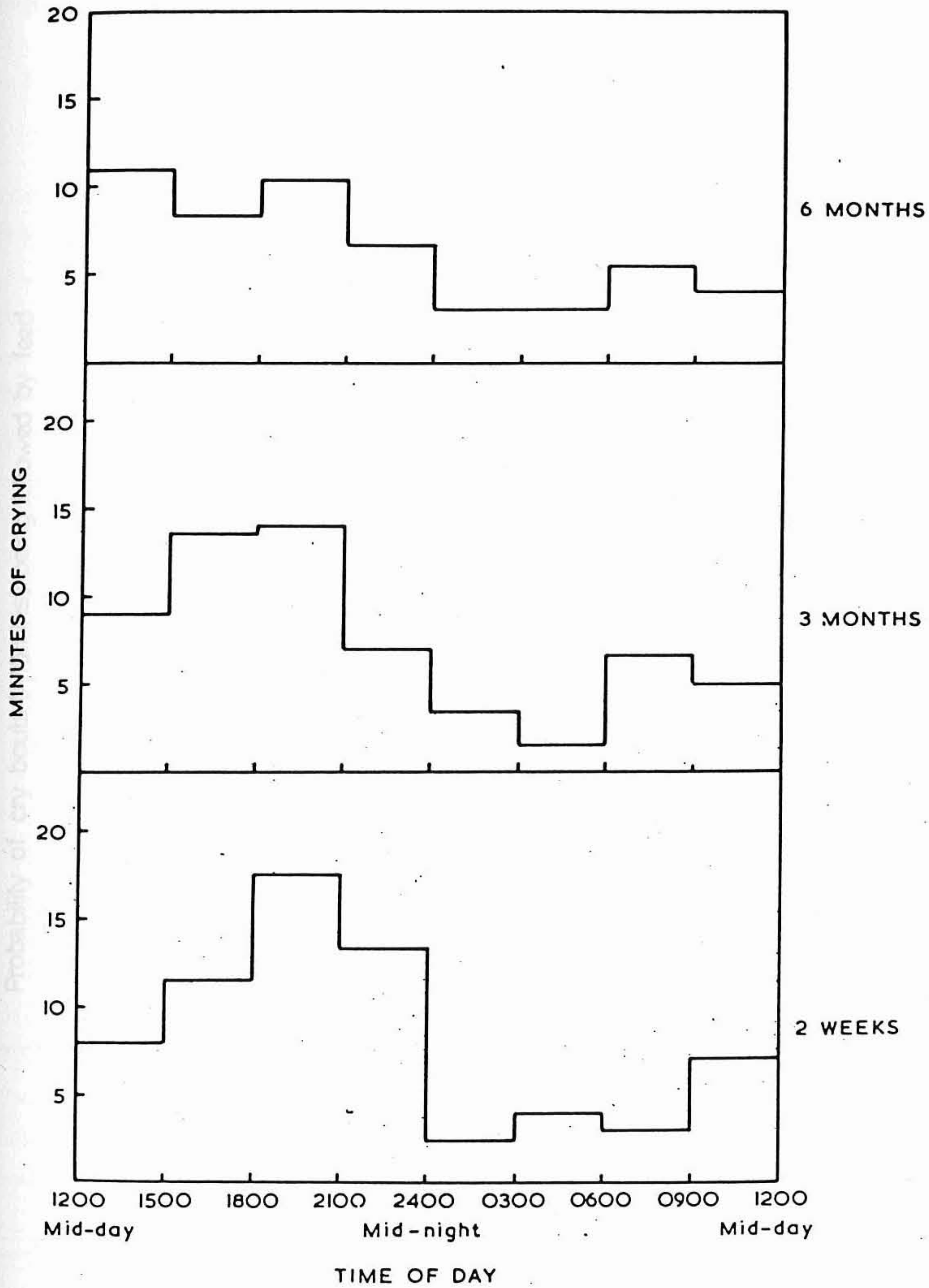

Figure 5.3: Daily patterns of crying (in 3-hour blocks) for infants at two weeks, three months and six months of age.

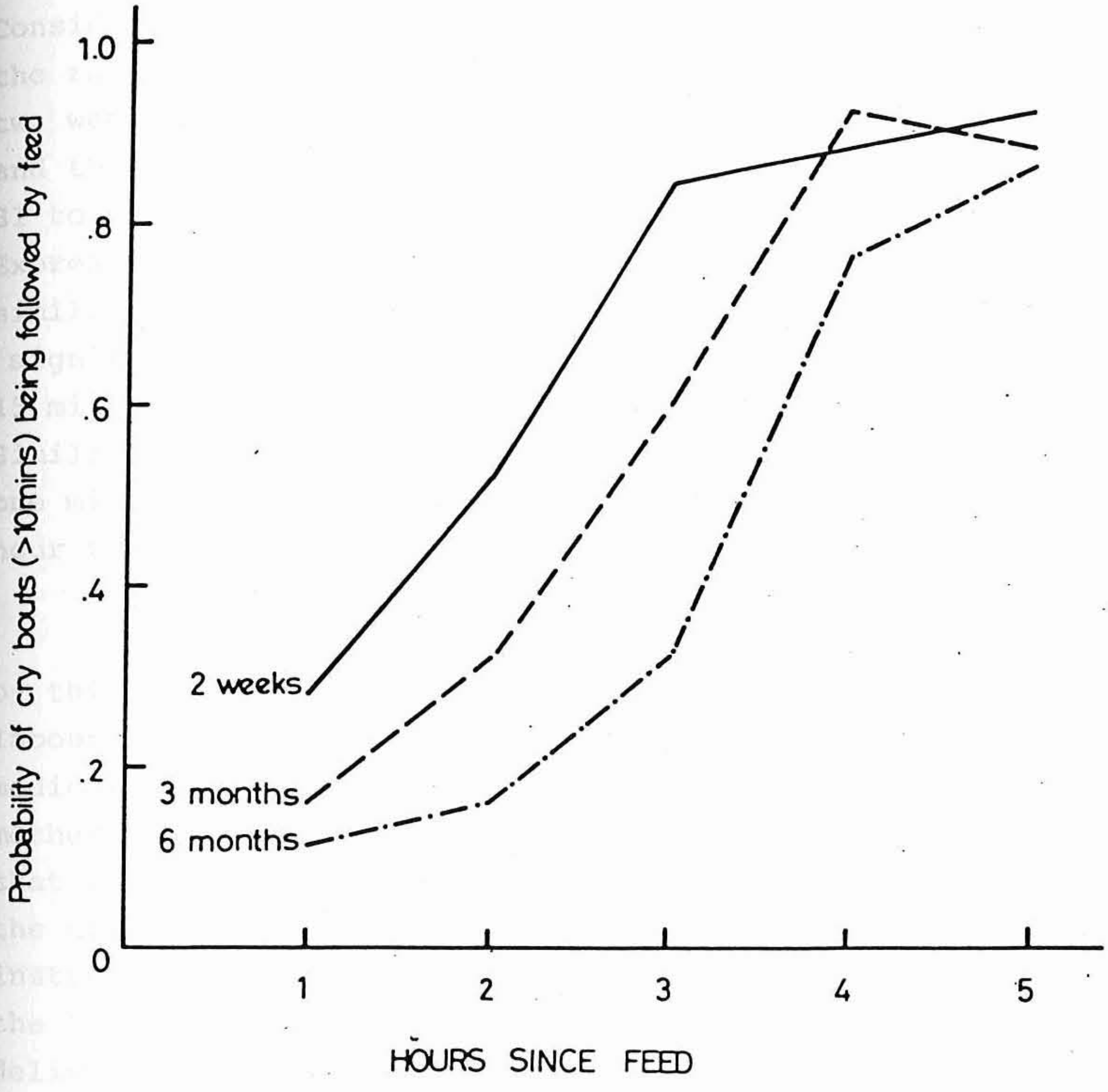

Figure 5.4: The probability of feeding following crying bouts > 10 minutes as a function of hours since last feed.

event in response to extended cries unless at least four hours had elapsed since the last feed.

5.6 Individual Differences

Figure 5.5 shows the distributions for the frequency of crying sequences obtained for this sample. Considerable individual differences were apparent, although the range narrowed over the six months of observation. At two weeks, the highest frequency of cry sequences was 53 and the lowest 6, while by six months the range was from 31 to 3 instances during the two hour observation session. Expressing fussing and crying in minutes per hour produced similar results, although the range did not appear to narrow significantly. At two weeks, the highest fuss-cry rate was 15 minutes per hour, and the lowest half a minute per hour. Similarly, at three months the range was from 22 minutes to one minute per hour, and at six months from 17 minutes per hour to almost no crying at all.

As has been suggested by a number of authors, some of this variability may be a function of the course of labour and delivery, particularly the amount of analgesic medication ingested by the mother. While data obtained from mothers about the births were not precise, it is clear that there were differences among them particularly in the use of painkilling medication and the necessity for instrumental assistance. It is possible to characterise the total sample in terms of the type of drugs taken during delivery: injected analgesic medication plus spinal anaesthesia (8); injected analgesic medication plus gas (12); injected analgesic medication alone (17); gas alone (11), no medication (6). All eight mothers who had spinal anaesthesia blocks required instrumental assistance to deliver and all had been administered pain-killing injections prior to the spinal anaesthesia. One way analysis of variance of the effect of drug group on hourly crying rates at two weeks failed to reveal any effect ($F = 3.12$, df - 4.49; $p > .05$). Although this

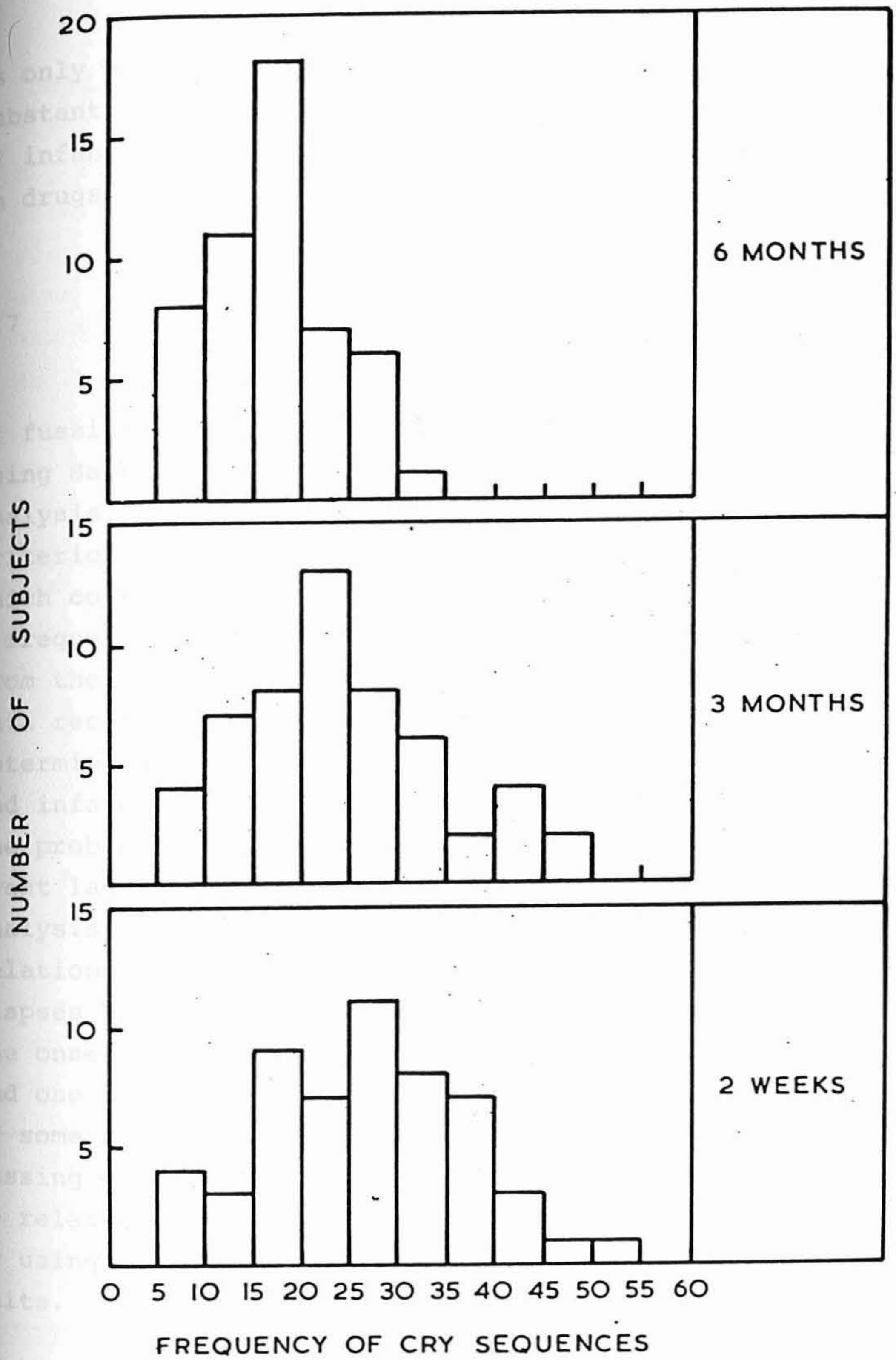

FIGURE 5.5: Distributions for frequency of cry sequences at two weeks, three months and six months of age.

is only a crude comparison, it does suggest that the substantial individual differences found in this group of infants probably cannot be ascribed to differences in drugs ingested by the mother during labour.

5.7 Events Preceding Fusses and Cries

The question of which stimuli precede the onset of fussing and crying can be approached in several ways using Sackett's (1979) technique of lag sequential analysis. The first, using the fuss or cry as the criterion requires the identification of those behaviours which coincide with the onset of fussing or crying with a frequency significantly greater than would be predicted from their occurrence at any one second instance in the data record (leading edge, lag 0). A second means of determining the same issue requires the use of each maternal and infant behaviour as a criterion and determination of the probability of occurrence of fussing or crying at various event lag steps subsequent to that behaviour (event lag analysis). More precise identification of the temporal relationship can be obtained by determining the time which elapses between the onset of the criterion behaviour and the onset of fussing or crying using a leading edge analysis and one second lag units. Similarly, since the termination of some behaviours (e.g. feeding) is likely to precipitate fussing or crying, the onset of fusses and cries can also be related to the offset of criterion behaviours of interest by using a trailing edge analysis based on one second lag units.

Since fusses and cries rarely occur as isolated events but rather occur in extended and uninterrupted sequence, and since the pattern of cry sequences may be related to precipitating stimuli, it was considered necessary to analyse precipitants separately for each of the four classes of fuss-cry events identified in Chapter 3 . If this procedure is not adopted then the lag analysis of behaviours preceding fusses and cries would be misleading. For example, a cry which followed immediately on a fuss would be entered separately into the analysis and any maternal response to the initial fuss would probably appear as an event precipitating the cry. Alternatively, the cry might be so remote from the initial precipitant that analysis would not reveal the connection.

Table 5.5 summarises the maternal and infant behaviours found to precede each of the fuss-cry events depicted in Figure 3.5 and the duration elapsing between the onset of identified precipitants and the onset of fusses and cries. It indicates for each event the obtained conditional and unconditional probabilities, chi square statistics (df = 1), and significance levels.

Behaviours identified using each of the fuss-cry events as a criterion and examining contingencies at lag 0 in a leading edge analysis are indicated by the symbol 0. Using each maternal and infant behaviour as a criterion in an event lag analysis and examining whether fusses and cries are significantly conditional at lags 0 or 1, the behaviours indicated by Δ were identified. Further lags were examined but are not reported here since it is difficult to attribute a precipitating role to such behaviours when others intervene between them and the onset of fussing or crying. In other words, only those maternal and infant behaviours which accompanied or immediately preceded fussing and crying are reported. Time of onset of fuss-cry events from the onset of significant precipitants was identified using a leading edge analysis.

Behaviours whose termination predicted the onset of each of the classes of fussing or crying are presented in Table 5.6 together with latencies from their offset to the onset of fussing or crying.

TABLE 5.5: Summary of results from lag sequential analysis indicating:
(i) Behaviours which are significant at the onset of fuss-cry events 0
(ii) Behaviours on which fuss-cry events are significantly conditional Δ and
(iii) the duration from the onset of behaviours to the onset of fuss-cry events.

Age of Infant	Fuss-Cry events	Significant Behaviours	Unconditional probability	Conditional probability	Chi-square	Latency from behaviour onset to onset fuss-cry
2 weeks	Fuss	M. Interrupts feed Δ I. Moves Δ	.044 .099	.152 .145	12.59*** 6.20*	3 8
	Fuss sequence	M. Interrupts feed Δ M. Puts down I. Δ I. Avoids feed Δ	.044 .131 .069	.179 .367 .196	9.96** 12.70*** 9.86**	4 9 3
	Cry†					
	Cry sequence	M. Puts down I. Δ	.131	.285	11.22***	4

†Too few instances were recorded to permit analysis.

continued..

Table 5.5 (continued)

Age of Infant	Fuss-Cry Events	Significant Behaviours	Unconditional probability	Conditional probability	Chi-square	Latency from behaviour onset to onset fuss-cry
3 months	Fuss	M. Restrains/ prohibits 0Δ	.103	.274	6.43*	6
		M. General caretaking 0Δ	.142	.286	5.62*	10
		M. Interrupts feed Δ	.087	.162	8.31**	
		I. Frowns Δ	.068	.141	4.97*	
	Fuss sequence	M. Puts down I. Δ	.163	.447	14.12***	5
		M. Restrains/ prohibits 0Δ	.084	.197	6.72**	3
		M. General caretaking 0Δ	.142	.249	5.03*	7
	Cry†					
	Cry sequence	I. Crash Δ	.066	.577	22.12***	3
		M. Moves away Δ	.119	.317	11.62***	7

†Too few instances were recorded to permit analysis

continued..

Table 5.5 (continued)

Age of Infant	Fuss-Cry Events	Significant behaviours	Unconditional probability	Conditional probability	Chi-square	Latency from behaviour onset to onset fuss-cry
6 months	Fuss	M. Moves away Δ	.078	.272	8.94**	6
	Fuss sequence	M. Moves away Δ	.096	.223	6.81**	9
		M. Puts down Δ	.161	.322	10.79**	5
		M. Restrains/ prohibits 0Δ	.102	.347	11.07***	4
		M. General caretaking 0Δ	.119	.291	6.13*	12
	Cry†					
	Cry sequence	I. Crash Δ	.067	.413	16.21***	4
		M. Puts down Δ	.161	.353	9.97**	7

†Too few instances were recorded to permit analysis

* p < .05
** p < .01
*** p < .001

TABLE 5.6: Results of a trailing edge analysis using each behaviour as a criterion.

Age of Infant	Fuss-Cry Events	Significant behaviours	Unconditional probability	Conditional probability	Chi-square	Latency from offset behaviour to onset fuss-cry
2 weeks	Fuss	Rocks	.097	.224	10.12**	4
	Fuss sequence	Rocks	.097	.207	8.23*	3
	Cry*					
	Cry sequence					
3 months	Fuss					
	Fuss sequence					
	Cry	None				-
	Cry sequence					
6 months	Fuss					
	Fuss sequence	Plays/entertains	.117	.213	6.56*	8
	Cry					
	Cry sequence					

* Too few instances were recorded to permit analysis

* $p < .05$

**$p < .01$

Two Weeks

At two weeks of age, only two maternal behaviours reliably predicted fussing in the group as a whole: the interruption of feeding and the cessation of rocking. Since rocking is typically a technique which mothers use in quieting crying infants, it seems likely that fussing precipitated by the termination of rocking represents a return to the state which occasioned the need for rocking in the first place. Similarly, sequences of fuss-cry events beginning with a fuss were also preceded by maternal interruption of feeding more frequently than would be predicted by the unconditional probability of this event.

The mother putting the infant down was also shown to precede sequences beginning with a fuss at this age. Furthermore, sequences beginning with a cry could also be predicted by this event, with the latency to cry being shorter than in the previous case. Together, these results suggest that the cessation of contact with the mother was highly likely to precipitate fussing and crying.

The only infant behaviours which reliably preceded fuss-cry events were generalized movement ("moves") and the avoidance of feeding, the latter usually accompanied by gagging and spitting, suggesting that the infant was experiencing discomfort during the feed.

Three Months

While the interruption of feeding continued to predict the prompt onset of fussing, maternal restraint of the infant, including that entailed in general care-taking activities such as diaper changing now provoked fussing. Both fussing alone and fuss-cry sequences beginning with a fuss could be predicted from these events. Being put down by the mother also continued to provoke crying sequences which built up slowly, while the movement of the mother out of the infant's field of vision now provoked a full blown cry, with a latency of about six seconds.

Only two infant events reliably preceded fusses and cries: frowning and 'crash'. The former, an infrequently coded event, provided one of the few obvious clues that the three month old infant was about to cry. The event 'crash' (see Appendix 4) predicted the immediate precipitation of a full blown cry, although it was, again, relatively infrequent.

Six Months

Activities involving restraint (restrains/prohibits; general caretaking) still predicted sequences beginning with a fuss when the infants were six months old. In addition to fussing when put down, the infant also began to fuss or would launch into a full blown cry with a latency of six-seven seconds when the mother moved out of the visual field. Interestingly, when maternal departure accompanied by talking was separately analysed, the fuss was no longer contingent ($X^2 = 3.97$; $df = 1$; $p > 0.05$). Infants of six months of age would also begin to fuss if the mother stopped playing with them, although the latency was relatively long (eight seconds).

The only infant behaviour to reliably precede any fuss-cry event at six months was 'crash', which led to a full blown cry.

5.8 Relationship between Frequency and Duration Measures of Crying

Because of the inherent confounding of the measure duration of infant crying with duration to maternal response, it was judged necessary to exclude it when carrying out the causal modelling procedure. Nonetheless, it is important to establish what relationships exist between this measure and that of frequency of fussing and crying, in order to assess whether both are reflecting the same processes. For example, it may be that infants who cried frequently, emitted cries which were of very brief duration, so that the overall amount of crying was actually less than that for an infant who cried infrequently but for very long durations. Since, however, the duration of the cry also reflects the number of cries to which mothers respond and their promptness in responding it was decided to examine correlations between the frequency of cries and the duration of cries subsequent to maternal response.

As indicated in Table 5.7, the observational measures of frequency and duration of fussing were uncorrelated, except at two weeks. On the other hand, frequency and duration of crying were highly correlated except at two weeks.

TABLE 5.7: Correlations between frequency and duration of fussing and frequency and duration of crying at two weeks, three months and six months of age.

Correlation between:	Age of Infant		
	2 weeks	3 months	6 months
(i) frequency and duration fusses	0.256*	0.2 0^{NS}	0.130^{NS}
(ii) frequency and duration cries	0.233^{NS}	0.534***	0.599***

NS = not significant
* = $p < 0.05$
*** = $p < 0.001$

In addition, there were significant correlations between the frequency measures of fussing and crying at each age, but none between duration of fussing and duration of crying (Table 5.8).

TABLE 5.8: Correlations between frequency measures of fussing and crying and between duration measures of fussing and crying at two weeks, three months and six months of age.

Correlation between:	Age of Infant		
	2 weeks	3 months	6 months
(i) frequency of fussing and frequency of crying	0.55***	0.359**	0.434**
(ii) Duration of fussing and duration of crying	0.049^{NS}	0.033^{NS}	0.048^{NS}

NS = not significant
** = $p < 0.01$
*** = $p < 0.001$

Combining fussing and crying and examining the correlations between the average duration of all cry sequences and the frequency of such sequences produced the results in Table 5.9. It is clear that, except at two weeks, these measures were significantly correlated. Part of this effect may have been a function of maternal delay in responding to cries. However, removing the duration to maternal response and examining the correlations between the total frequency of cry sequences and the duration of such sequences subsequent to maternal response als produced significant correlations of similar magnitude (Table 5.9), with the qualification that the correlation at two weeks was also significant. Taken together,

TABLE 5.9: Correlations between frequency and duration of cry sequences at two weeks, three months and six months of age.

Correlations:	Age of Infant		
	2 weeks	3 months	6 months
(i) frequency cry sequences and $\bar{X}$ duration of all cry sequences	0.21^{NS}	0.43**	0.52***
(ii) frequency of cry sequences and $\bar{X}$ duration of cry sequences subsequent to maternal response	0.39**	0.51***	0.47**

NS = not significant
** = $p < 0.01$
*** = $p < 0.001$

these results suggest that infants who cried frequently also had the longest duration of cry sequences. The possible influence on cry duration of maternal effectiveness in terminating cries will be examined in the next chapter.

5.9 Relationship between Crying and Other Infant Behaviours

The relationships between the amount of crying exhibited in the observation sessions and other infant behaviours considered important in mother infant interaction were assessed. Infants varied considerably in the amount which they smiled, vocalized and looked at the mother, as well as in the likelihood that they would respond in these ways to maternal behaviour directed to them during interaction. Both these attributes were used as indices of the quality of the infant's input into the mother-infant interaction.

One of the problems in characterising the quantity of these social behaviours is that mothers also vary in the extent to which they participate in interaction. Thus, it is important to express these behaviours as a proportion of the available interaction time. This was assessed by calculating for each infant the amount of time during which the mother was interacting with the infant, excluding time taken up with feeding and crying. Crying time was excluded since this was to be correlated with the other behaviours and for the irritable infant it may significantly reduce the time available for other interaction. Similarly, infants varied considerably in the proportion of time spent feeding, and since there is little opportunity to exhibit other behaviours during feeding this time was also excluded from the interaction time index.

At each age, the proportion of corrected interaction time taken up by smiling, vocalizing (other than crying) and looking at the mother (unaccompanied by smiling or vocalizing) was calculated for each infant. In addition, the probability of each of these behaviours following any maternal behaviour during the interaction was calculated using lag sequential analysis. Both these indices were Arcsin transformed.

Table 5.10 shows for all infants the percentage of corrected interaction time taken up by smiling, vocalizing and looking and the probability of these behaviours following maternal behaviour (at two weeks, three months and six months of age).

Two way analysis of Arcsin transformed percentages showed an effect due to age, but none to the sex of the infant ($F = 11.42$, $df = 2,104$; $p < .001$). This suggests that as the infants matured they became more active participants in interaction with their mothers. A similar analysis of the probability of crying, smiling and vocalizing (Arcsin transformed) immediately following a maternal behaviour during such interaction, produced

TABLE 5.10: Percentage of interaction time represented by smiling, vocalizing and looking and the probability of these behaviours following maternal behaviour.

Age of Infant	% Interaction Time	Probability
2 weeks	11%	.24
3 months	29%	.31
6 months	43%	.44

a similar result. There was a clear age effect ($F = 8.16$, $df = 2,104$, $p < .001$) but none due to the sex of the infant.

Correlations between both these indices and the frequency of crying sequences within age periods are shown in Table 5.11.

TABLE 5.11: Correlations between frequency of cry sequences (1), % interaction time spent smiling, vocalizing and looking (2), and the probability of these responses following maternal behaviour (3).

Age of Infant	Correlations		
		1	2
2 weeks	2	$.11^{NS}$	
	3	$-.04^{NS}$	$.09^{NS}$
3 months	2	$.17^{NS}$	
	3	$.09^{NS}$	.42**
6 months	2	.39**	
	3	.34**	.47**

NS = not significant
** = $p < 0.01$

At two weeks there were no significant relationships among the variables, but at three months the proportion of interaction time during which the infant smiled, vocalized and looked at the mother was positively correlated with the probability that any of these responses followed a maternal behaviour. This association also held at six months. Only at six months was there any relationship between these variables and infant crying. The correlation was positive, indicating that those infants who cried most frequently spent a greater proportion of available interaction time smiling, vocalizing and looking at the mother and were more likely to immediately follow her behaviours with one of these responses.

5.10 Summary of Results

There was, not surprisingly, a clear decline with age in the total amount of crying. This was evident for both frequency and duration measures of crying, although not for fussing. It was also true for the frequency of crying sequences and for hourly rates of crying, and in the latter case, whether rates were determined from observational records or maternal diaries. In other words, infants cried less frequently as they matured and the average duration of cries was shorter.

For both frequency and duration measures there were substantial individual differences over all three time periods. In addition, the correlations between the frequency of cry sequences and the average duration of such sequences indicated that infants who cried most frequently also cried for the longest even when the effect of maternal behaviour was taken into account. There were no sex differences in any of these measures, nor were there any differences in crying at two weeks attributable to the amount and type of drugs used by the mother during labour.

Maternal records of daily crying showed a peak of crying in the evenings which diminished somewhat with age. Extended bouts of crying (> 10 minutes) at two weeks were likely to result in a feed if more than three hours had elapsed since the last feed. The same pattern was evident at later ages, although feeding was relatively unlikely unless at least four hours had passed since the previous feed.

Lag sequential analysis revealed predictable antecedents to cries which did not systematically vary with the nature of the fuss-cry event although they did change with the age of the infant. The most notable feature of these results, however, was that loss of body contact or movement of the mother out of the infant's visual field was significantly associated with crying across all three age periods.

Correlations between the frequency of cry sequences and indices of the amount of smiling, vocalizing and looking during interaction with the mother showed that, at six months but not before, those infants who cried the most also showed the most social behaviour during interaction. Furthermore, the probability of any of these behaviours following maternal behaviour during such interaction was significantly and positively associated with the amount of infant crying at six months.

B: Discussion

5.11 The Amount of Crying in the First Six Months

Infant crying has frequently been ascribed a central role in mother-infant interaction, particularly in ensuring close contact between mother and infant (Ainsworth, 1969; Bowlby, 1969). Crying is one of the few easily perceptable signals which the newborn infant has available. It is a potent signal (Ostwald, 1972) which is not easily ignored. Furthermore, persistent high rates of crying are of considerable concern to mothers (Bennett, 1981) and excessive crying may seriously jeopardise the mother-infant relationship (Martin and Beezley, 1974).

For the sample of infants studied in this investigation crying[1] was a very common behaviour, representing 14% of recorded infant behaviours and occupying 11% of observation time when infants were observed at two weeks of age. Although there was an age-related decline in the amount of crying, it still accounted for 9% of infant behaviours and 7% of observation time at the six month observations. These estimates are comparable with those obtained from the only other study in which a sizeable sample of infants was observed over the same age range (Bell and Ainsworth, 1972).

A decline with age in the amount of crying was evident in data obtained from both the home observations and the maternal diaries, and both produced comparable estimates of hourly crying rates. Furthermore, there was a decline in both the frequency and the duration of cry sequences. As infants matured they exhibited fewer cry sequences and the sequences were briefer. Separate analyses of fusses and cries showed that this effect was due to a change in the frequency and duration of cries, since neither of these attributes of fussing changed over the six months of observation.

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[1]Unless otherwise specified, crying will refer to combined fussing and crying.

A number of investigators have reported similar age changes in the amount of crying (Bell and Ainsworth, 1972; Emde *et al.*, 1976; Moss, 1967; Rebelsky and Black, 1972). A decline in hourly rates of crying similar in magnitude to that reported here was obtained by Bell and Ainsworth (1972) although they found no decline in the frequency of cries up to 12 months of age. This discrepancy may be due, in part, to their observation procedure which apparently precluded the precise identification of separate cry sequences. Age changes in the amount of crying were also reported by Rebelsky and Black (1972), although the hourly rates they obtained were lower than those reported here. Although they did not analyse frequency and duration measures separately, these authors did find a diminution of hourly crying rates up to three months. Between three weeks and three months of age, Moss (1967) too reported a decline in combined fussing and crying estimated by a modified frequency (MF) procedure. He showed that much of this change was the result of a decline in the amount of crying and not fussing, a finding consistent with that obtained in this investigation. Since the MF procedure does not produce independent estimates of frequency and duration, it is not possible to ascertain from the Moss results whether the decline reported was due to changes in the frequency or the duration of cries or of both attributes.

There was a corresponding increase with age in the proportion of non-crying interaction time during which infants smiled, vocalised and looked at their mothers. This finding is consistent with Moss's (1967) observations that at three months of age the infants in his study were more likely to smile, vocalise and look at their mothers than they had at three weeks. In addition, in the present study, the probability that these behaviours would immediately follow on maternal behaviour also increased as the infants matured, suggesting an increased facility in the infants for turn-taking interaction. These findings indicate that the infants became more active and responsive partners in interaction with their mothers, a result which is to be expected since this period is characterised by rapid maturation and learning.

As Newson (1977) and Trevarthen (1977), among others, have observed, it is clear that right from birth infants are able to participate in two-person interactions which have a distinctly conversational quality. Newson has further argued that because these exchanges are often highly repetitive, the baby learns to play an active role and to "offer with some certainty the appropriate actions which are required of him to sustain the chain of reciprocal activity" (p. 51).

Together the data obtained on age changes in crying and social behaviour suggest that crying is steadily replaced by smiling, looking and vocalising as a means of capturing the mother's attention and facilitating interaction with her.

5.12 Daily Patterns of Crying

Data from maternal diaries indicate that crying was not spread evenly over the day. At two weeks, a peak of crying was reached between 6 p.m. and midnight, a finding comparable with that reported by Bernal (1972) who also used maternal diaries to estimate crying. This peak was less pronounced at later ages, but the afternoons and evenings continued to be the times at which most crying was recorded. A number of other writers have also observed that regular crying in the evenings is very common among young babies (Illingworth, 1954 ; Dunn, 1975). Indeed this is the period during which so-called "colicky" babies are likely to exhibit the excessive crying which invites that diagnosis. Illingworth has commented that "the outstanding impression given by the colicky baby, except in the evening, is that he is a well, happy, thriving, well-fed and well-managed baby with nothing wrong with him" (p.166).

Reasons for this rise in crying toward the end of the day cannot be ascertained from the present data. However, it has been suggested that it may be the result of mothers having other domestic responsibilities at this time which preclude close contact and interaction with the infant (Illingworth, 1954). However, Bernal's (1972) data indicate that this may not be the case, since the infants in her study were less likely to be left in the cot unattended in the evening than they were earlier in the afternoon. She also observed that breastfed babies were more likely than bottle-fed babies to cry in the evenings and attributed this to the reduced quantity of breastmilk available in late-afternoon feeds. This may account for the pattern of crying observed in this sample of infants, since the majority were being breastfed.

Since mothers typically adopted flexible feeding schedules, there were no rises in the amount of crying at times of the day which might be regarded as regular mealtimes as reported by Rebelsky and Black (1972). However, examination of the timing of feeds show that extended periods of crying (> 10 minutes) were frequently followed by a feed, with the likelihood of a feed increasing as the time since the last feed increased. At two weeks, approximately 80% of such cries resulted in a feed if at least three hours had elapsed since the last feed. When the infants were older, the same probability of feeding in response to extended bouts of crying was not reached until four hours had elapsed. Mothers obviously required infants to wait longer for a feed as they matured. This is consistent with data from the naturalistic observations which showed that feeding was one of the events significantly conditional on crying.

5.12 Individual Differences

As reported in other studies (Bell and Ainsworth, 1972; Moss, 1967; Rebelsky and Black, 1972), individual differences in both the frequency and the average duration of cry sequences were substantial. Some infants cried for as much as a quarter of the observation time while others exhibited almost no crying at all. In addition, there were significant correlations between the frequency and duration of cry sequences, indicating that infants who cried most frequently also cried for longest.

The duration of cry sequences obviously depends in part on maternal delay in responding and maternal effectiveness in terminating cries. Results to be reported in Chapter 6 will show that infants who cried most frequently also had mothers who ignored a greater proportion of their cries and delayed longer in responding than infants who cried less frequently. However, the longer cry sequences typical of infants who cried frequently cannot be entirely attributed to this association, since removing the duration to maternal response from the duration of cries, still produces a positive correlation between the frequency and duration of cry sequences. This indicates that those infants who cried most frequently also took longest to quiet after maternal intervention. It is unlikely that maternal behaviour entirely mediates this association, since there was no relationship between maternal delay in responding to cries and the duration of crying subsequent to maternal response at two weeks, although there were significant correlations at three and six months.

Individual infants were remarkably consistent in the amount of crying they exhibited over the three observations. Correlations across observations in the frequency of crying were all significant. Moss (1967) also reported continuity in infant fussing and crying between three weeks and three months, although somewhat less than in this study. Similarly, Rebelsky & Black (1972) found some individual consistency in the amount of crying, since infants in their study differed more from each other than they did from themselves over the first three months of life. In a recent study Fish and Crockenberg (1981) examined infant behaviours from birth to nine months and found substantial individual consistency in the amount of fussing and crying over that period. This was particularly significant since only one other behaviour (motor activity) showed such consistency. All of these results are at odds with those reported by Bell and Ainsworth (1972) who found little individual continuity in fussing and crying over the first six months and attributed later stability to the influence of maternal behaviour.

The question of whether the consistency observed in this sample of infants is the result of maternal behaviour in response to crying will be examined further when the issue of the direction of effects is discussed more fully.

5.14 Relationship of Crying to Pregnancy and Delivery Variables

A number of prenatal and perinatal variables have been found to affect the amount of crying in newborns. Although this investigation was not specifically designed to determine the contribution of these variables to early individual differences in the amount of crying, it is possible to examine their effects, albeit crudely, since pertinent data were collected. Among the variables argued to be important are parental status variables such as maternal age and parity, socio-economic status, ethnicity, education and matital status. None of these could have significantly affected the range of crying seen in the present study since mothers were deliberately selected to be homogeneous with respect to these variables and to fall in the optimum range. All women were married, white, well-educated and expecting their first child. They also fell within the age range (20-35) considered to be optimal for uncomplicated pregnancy and delivery. Similarly, none of the women experienced serious health problems during pregnancy, although four were induced into labour, reputedly for high blood pressure which has been shown to retard the foetal growth rate and to affect irritability measured by Brazelton examination (Chisholm, Woodson and da Costa Woodson, 1978). However none of the infants born to mothers with high blood pressure was of low birth weight and they were not among the highest scorers in terms of the amount of crying, ranking 7th, 13th, 32nd and 40th respectively at two weeks.

The course of labour and delivery has also been shown to be important in affecting newborn behaviour (Standley *et al.*, 1978). While recognizing that data obtained from mothers about the births may not have been entirely reliable it is clear that there were differences among them particularly in the use of pain-killing medication and instrumental assistance. Analysis of variance of the effect of drug group on hourly crying rates at two weeks failed to reveal any effect, suggesting that the individual differences found in this group of infants probably cannot be ascribed to differences in drugs ingested by the mother during labour.

5.15 Sex Differences

Results showed that there were no sex differences in any of the infant crying variables estimated from maternal diaries and observational records. This is consistent with Bell and Ainsworth's (1972) and Fisichelli *et al.*'s (1974) data obtained over the same age period. Moss (1967), however, found higher rates of fussing (but not crying) among males at both three weeks and three months of age. However, males also spent more time awake, so the greater amount of fussing for males may have been the result of them having more opportunity to do so. This was not a problem in the present study since observations were conducted only when infants were awake. In addition, many of the males in Moss's study would have been circumcised, a practice known to produce greater lability of state and increased irritability (Anders & Chalemian, 1974). Only two of the males in this study were circumcised.

5.16 The Relationship between Crying and Social Behaviour during Interaction

There were also substantial differences among infants in the proportion of non-crying interaction time during which they smiled, vocalised and looked at the mother and in the probability that these behaviours would follow maternal behaviour. Both these indices have been used to characterise the quality of the infant's input into mother-infant interaction (Field, 1977).

At two weeks and three months these characteristics were not associated with the amount of crying exhibited, but by six months there was a strong positive association. At this time, the infants who cried most were also those who spent proportionately more time smiling, vocalising and looking at the mother and these responses were more likely to be contingent on the mother's behaviour. These results suggest that the babies who cry a lot are not necessarily unresponsive or deficient in social behaviour as has frequently been assumed. Indeed, at six months, they are the most socially responsive.

No other study has examined the relationship between these variables over the same time period, although Bell and Ainsworth (1972) did report an inverse association between the amount of crying and observers' ratings of the subtlety, variety and clarity of infants' facial expressions, gestures and vocalisations at one year old . Specific details about the nature of the rating scales, their reliability, or the methods by which composite scores were obtained were not provided, so it is difficult to have confidence in this result.

The relationship between crying and social behaviour across age periods will be discussed in the chapter on longitudinal changes.

5.17 Behaviours preceding Cries

One of the issues raised in Chapter 1 was the question of why babies cry. Explanations from both attachment and learning theory were explored. Before the adequacy of either explanation can be assessed, it is necessary to determine what conditions actually do precipitate crying. While it is impossible to address this question comprehensively, particularly since many cries appear to be without external precipitants, it is possible to identify from observations those maternal and infant behaviours which precede or accompany crying more often than would be expected from their occurrence in the total data record.

Lag sequential analysis revealed several predictable antecedents to cry sequences. Although four classes of fuss-cry event were distinguished, there were no clear associations between precipitants and the nature of the fuss-cry events, except for the event 'crash' which invariably resulted in a full blown cry. For this reason, results on antecedents to cry sequences will be discussed without reference to the nature of the subsequent fuss-cry event.

At two weeks, two infant behaviours reliably preceded crying sequences: the avoidance of feeding and generalised movement. In the former case, it is likely that infants were experiencing discomfort during feeding and this led to them pulling away from the nipple and crying. Generalised movement, a code encompassing wriggling and vigorous movement of the limbs, also predicted imminent crying. Konner (1974) after observing mother-infant interaction among the !Kung of the Kalahari, argued that the mother's perception of such movement while the infant was carried close to her body, allowed her to anticipate crying and to intervene rapidly to prevent the development of a full blown cry. He suggested this as one reason for the relatively small amounts of crying seen among !Kung infants.

By three months, frowning had replaced movement as the major infant behaviour which preceded crying. Apart from this 'crash' was the only other infant event to reliably precede crying. The relationship between 'crash' and crying is not surprising since the code encompassed events likely to result in hurt to the infant. At both three months and six months, when this event was also significant, the outcome was a full blown cry, a finding consistent with Wolff's observations that the infliction of pain to the infant is likely to result in a cry which begins at high levels of amplitude and density.

Of the maternal behaviours coded, interruption of feeding was a significant antecedent to cries at two weeks and three months. Other workers (Wolff, 1969; Yang *et al.*, 1976) have also found that interruption of feeding, particularly early in the feed, is likely to precipitate crying. Wolff (1969) reported that crying in week old infants was most vigorous after the first interruption when the baby had taken less than one ounce of formula. It may be that part of this effect is due to the interruption of sucking, since Yang *et al.* (1976) were able to elicit crying in newborns by simply removing a rubber nipple on which they had been sucking. The non-significance on feeding interruption at six months is also consistent with Wolff's (1969) finding that crying after this event became increasingly less likely after six weeks.

Any restraint of the infant's activity, including that entailed in general caretaking was also found to precede crying, but only at three and six months of age. The younger infant is not sufficiently active to provoke maternal activity encompassed in the code "restrains/ prohibits". Furthermore, swaddling and curtailment of infant movement have been found to have a soothing effect on the newborn (Wolff, 1969). Data from this study suggest that for the infant older than three months, restraint is aversive, particularly when the infant is in an alert state. For the mobile six month old, the activity of nappy changing coded in general caretaking was particularly likely to provoke fussing and crying. There is little in the literature with which to compare this finding, although Pratt (1981) suggested that actions by the mother judged likely to produce frustration in the infant often resulted in crying. Wolff also reported that undressing or uncovering infants would frequently provoke crying.

The interruption of rocking at two weeks and three months and of play at six months also produced crying. Since rocking is a technique which mothers often use to soothe the crying infant, it is likely that crying in this situation is a continuation of that which occasioned the need for rocking in the first place. Crying on the interruption of play probably represents an attempt by the infant to ensure continuation of play.

The events most consistently implicated in the onset of crying were those involving reduced proximity to the mother. At all three ages, being put down was an event likely to precipitate crying and at three and six months, losing sight of the mother also preceded crying more often than would be expected from the unconditional probability of this event. This finding is consistent with Bowlby's (1969) and Ainsworth's (1969) argument that babies are genetically programmed to cry when out of contact with the mother since being alone is a "natural clue" to danger. Their basic assumption is that crying, like other attachment behaviours evolved in order to protect the infant, particularly from predators, by ensuring close contact with adults.

However, it is also compatible with the learning theory explanation of "separation protest". Although Gewirtz (1977) was referring to the older infant's specific attachment to the mother, the implication of his argument is that infants will learn to cry upon separation from any caretaker who provides "positive reinforcing stimuli for infant cries". He has argued that the mother becomes a discriminative stimulus for reinforcement and a secondary reinforcement stimulus. The child cries upon separation because he or she has learned that the mother's absence is often associated with pain and discomfort and that crying is effective in producing the mother's return. It is possible that such learning could take place as early as two weeks, although it seems unlikely. The further implication of Gewirtz' argument is that operant crying of this kind acquires strength when crying results in the infant being picked up, talked to and fed and diminishes when such crying is ignored. Evidence for this position will be examined further in discussion of the long term changes in and direction of influence between infant crying and maternal response.

CHAPTER 6

RESULTS AND DISCUSSION II : MATERNAL RESPONSES TO CRYING

6.1 Introduction

In this Chapter data on the research aims pertinent to maternal responses to crying are reviewed and discussed. The chapter begins with an examination of mothers' attitudes to the management of crying. There follows an analysis of changes over the six months in the overall proportion of fusses and cries to which mothers respond and in the latency to respond. The relationships between these measures of maternal responsiveness and prenatal attitudes to the management of crying are described, together with results on the association between the amount of crying exhibited by infants over the six months and mother's attitudes to crying at the end of that period. This is followed by a summary of group results on maternal responses which are significantly contingent on fussing and crying at each age, together with data on the average latencies of such responses. Following this is an analysis of the relationships between the circumstances which elicit fussing and crying and

(i) the probability of maternal response,
(ii) the promptness of responses, and
(iii) the type of response made.

The effectiveness of the various responses in terminating cries and the association between events which precede cries and the effectiveness of various maternal responses are described. The section concludes with results on the correlations between measures of maternal response to crying, measures of effectiveness in terminating cries, and indices of the quantity and quality of mother-infant interaction. All these findings are discussed in Section B of the chapter.

A: Results

6.2 Maternal Attitudes to Crying

Mothers were questioned both before the birth of their infants and after the six month observations on their attitudes to a number of child rearing questions, including the management of crying. Table 6.1 gives the items relevant to crying, the mean scores and standard deviations on each occasion. Since the other items were "filler" items designed to ensure that the mothers were not aware of the research hypotheses, they will not be reported. Items were scored on a six point scale from strongly agree (1) to strongly disagree (6).

Separate t-tests for correlated observations (Winer, 1962, p. 39) conducted on each item reveal significant differences between the two occasions of measurement on all but three items (2, 3 and 9). The direction of the difference indicates that as a group mothers become less "permissive". For example, while agreeing on the first occasion with the statement that babies would cry more if they were ignored, they disagreed with the same statement at the six month follow-up. Similarly, mean scores indicate a change from agreement to disagreement on the item which stated that a six month old baby should be picked up when he or she cried. Furthermore, while disagreeing initially with the statement that babies would cry for attention if they were not sometimes ignored, by the six month observation they agreed with the same statement. Similarly, while the mean score on item 8, "a mother should ignore her child's crying when it is just for attention", indicated disagreement on the first occasion, it had shifted to agreement by six months. On other items the changes observed were a matter of degree, rather than from agreement to disagreement or vice versa. The fact that standard deviation scores were similar on both occasions of measurement suggests that the overall shift in attitudes observed was not a function of a few extreme cases.

Table 6.1: Scores on items assessing maternal attitudes to crying during the third trimester of pregnancy and after the six month observations.

Item	Prenatal Scores		Six Month Scores			
	$\bar{X}$	SD	X	SD	t	p
1. A newborn baby doesn't cry unless something is wrong.	1.5	.723	3.7	.941	2.142	<.05
2. Holding and caressing a baby when he(she) cries is good for him(her).	2.3	.492	3.1	.716	1.830	NS
3. When a child cries his(her) mother should comfort him(her).	2.7	.617	3.4	.812	1.763	NS
4. If a baby's cries are ignored this will make him(her) cry more.	1.9	.872	4.2	.727	2.124	<.05
5. A six month old baby should be picked up when he(she) cries.	2.4	.841	4.7	.713	2.275	<.05
6. If mothers do not ignore some of the baby's cries he(she) will learn to cry just to get attention.	5.1	.722	2.9	.921	2.095	<.05
7. A child should not be permitted to cry for long.	1.4	.696	3.6	.804	2.371	<.05
8. A mother should ignore her child's crying when it is just for attention.	4.9	.721	2.4	.565	2.722	<.01
9. The six month old baby should sometimes be left to cry.	3.9	.976	2.6	.921	1.935	NS

Factor analysis (principal factor with iteration) of mothers' responses to these items produced a single factor solution (Table 6.2), which accounted for 76.7% of the variance. Scores on items 6, 8 and 9 where a high score indicated permissiveness, were reversed to ensure comparability of all item scores.

TABLE 6.2: Factor loadings for items on the management of crying.

Item	Prenatal Factor Loading	Post-observation Factor Loading
1	.708	.678
2	.812	.743
3	.732	.826
4	.675	.612
5	.564	.483
6	.662	.535
7	.831	.826
8	.503	.610
9	.697	.724

The correlation between the mothers' factor scores on the two occasions of measurement ($\gamma = .12$) failed to reach significance, indicating that mothers were not consistent in their attitudes over the six months of the study.

6.3 Maternal Responsiveness to Cries

Potentially all the maternal events recorded could be considered to constitute responses to fusses and cries. However, of the responses coded, two were clearly not likely to involve interaction with the infant and were not included in the analysis: (a) simply looking in the infan't direction without making eye contact ("attends").

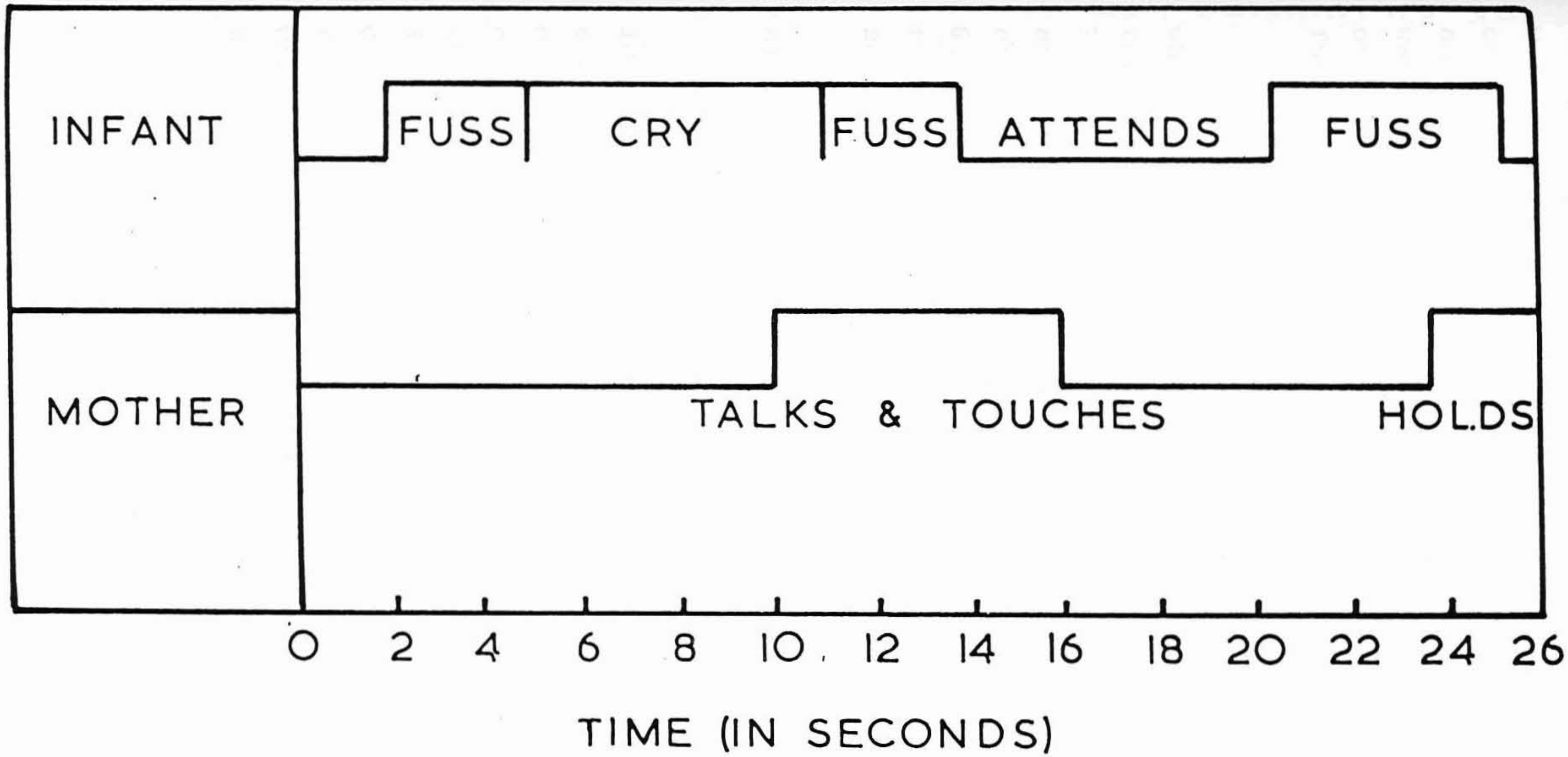


FIGURE 6.1: An illustrative example of two cry sequences indicating latency to maternal response.

and (b) moving away from the infant so that interaction was no longer possible ("moves away"). Similarly, some of the responses coded were clearly aversive and were analysed separately (e.g. physical punishment). An event was recorded as having been in response to a fuss or cry only if it was initiated *during* the occurrence of that fuss or cry.

In measuring the proportion of fuss-cry events to which mothers responded and the latency to respond, responses were counted separately for each new crying. Furthermore, only the presence or absence of response and not the number of different responses made was calculated. Consider the sequence illustrated in Figure 6.1. Two separate cry sequences would be identified and two maternal responses, the first with a latency of 8 seconds and the second with a latency of 4 seconds.

a) Percentage of cries to which mothers respond

Examination of the percentage of separately identified cry sequences to which mothers responded at each age period shows a clear decline over the three observations (Table 6.3). Two-way analysis of variance of Arcsin transformed percentages reveals an age effect ($F = 21.174$; $df = 2,104$; $p < .001$) but no sex x age interaction. Inspection of Table 6.3 shows that the older the infant the less likely the mother was to respond, with most of the change occurring between two weeks and three months. Full details of ANOVA results are given in Appendix 6.

Table 6.3: Percentage of cry sequences to which mothers respond and mean response latencies at two weeks, three months and six months.

	2 weeks		3 months		6 months	
	Males	Females	Males	Females	Males	Females
% cry sequences to which mothers respond	85.9	82.2	67.9	71.9	65.5	69.4
Response latency	6.7	7.1	8.9	9.3	13.3	9.6

b) <u>Response latency</u>

Examination of mean latencies to respond (Table 6.3) suggests that mothers also delayed longer in responding to fusses and cries as the infant matured. There is a clear age effect ($F = 6.913$; $df = 2,104$; $p < .01$) and also a sex x age interaction ($F = 4.917$; $df = 2,104$; $p < .05$). Inspection of the means suggests that this effect is due to the fact that mothers of males were likely to delay longer than mothers of females, but only at the six month observation. ANOVA results are appended (Appendix 6).

c) <u>Maternal response as a function of the composition of full-cry sequences</u>

Differences in maternal response on the basis of the composition of fuss-cry sequences are evident.

Responses to each of the categories of fuss-cry events identified in Chapter 3 and illustrated in Figure 3.5 are given in Table 6.4.

At two weeks fusses occurring in isolation were responded to on only 52% of occasions they occurred and with a relatively long latency. Part of this effect may be attributable to the short average duration of these events (3.91 seconds) which precludes the possibility of a response. Only those which continued for longer obtained a response and then only after some delay. This trend was more pronounced at the later observations, so that by six months mothers responded to only 21% of fusses which did not develop into cries and their responses were relatively delayed.

Cries occurring alone, infrequently coded events (4.7% of all cries), were all responded to at two weeks, and promptly. This high rate of prompt response continued to be evident at the later observations. A similar pattern is seen for more extended sequences beginning with a cry. Mothers seemed to treat such events as urgent and requiring prompt attention. Virtually all obtained a response with a short average latency when compared to fusses or to sequences beginning with a fuss. This pattern seemed relatively constant over the three observations.

For sequences beginning with a fuss the latency to respond was longer and the proportion which were ignored altogether was much greater than for sequences beginning with a cry or for isolated cries. Furthermore, mothers ignored more of these events and delayed longer as the infants matured.

Table 6.4: Percentage of responses and mean response latencies for four types of fuss-cry event.

Event	2 weeks		3 months		6 months	
	% response	response latency	% response	response latency	% response	response latency
Fusses alone	52	9.6	43	11.5	21	18.3
Cries alone	100	4.7	94	5.6	91	5.4
Sequences beginning fuss	82	6.9	79	7.4	71	10.6
Sequences beginning cry	97	5.1	92	5.9	93	6.1

6.4 Individual Differences in Responsiveness

As indicated in Figure 6.2, the mothers studied in this investigation were initially relatively homogeneous with respect to the proportion of cries to which they responded. Beyond two weeks, however, the distributions spread out considerably. A similar pattern was found for mean response latency to cries (Figure 6.3) although the change was less pronounced. While there was a relatively narrow range of delays for this sample at two weeks, it widened over the period of observation. Furthermore, correlations across the three age periods showed little consistency in these attributes of maternal response (Table 6.5 and 6.6), since only two correlations were significant.

TABLE 6.5: Correlations between indices of % response across age periods

Age of Infant	2 weeks	3 months	6 months
2 weeks	1.00		
3 months	0.23^{NS}	1.00	
6 months	-0.25^{NS}	0.66***	1.00

NS = not significant

** = $p < .01$

*** = $p < .001$

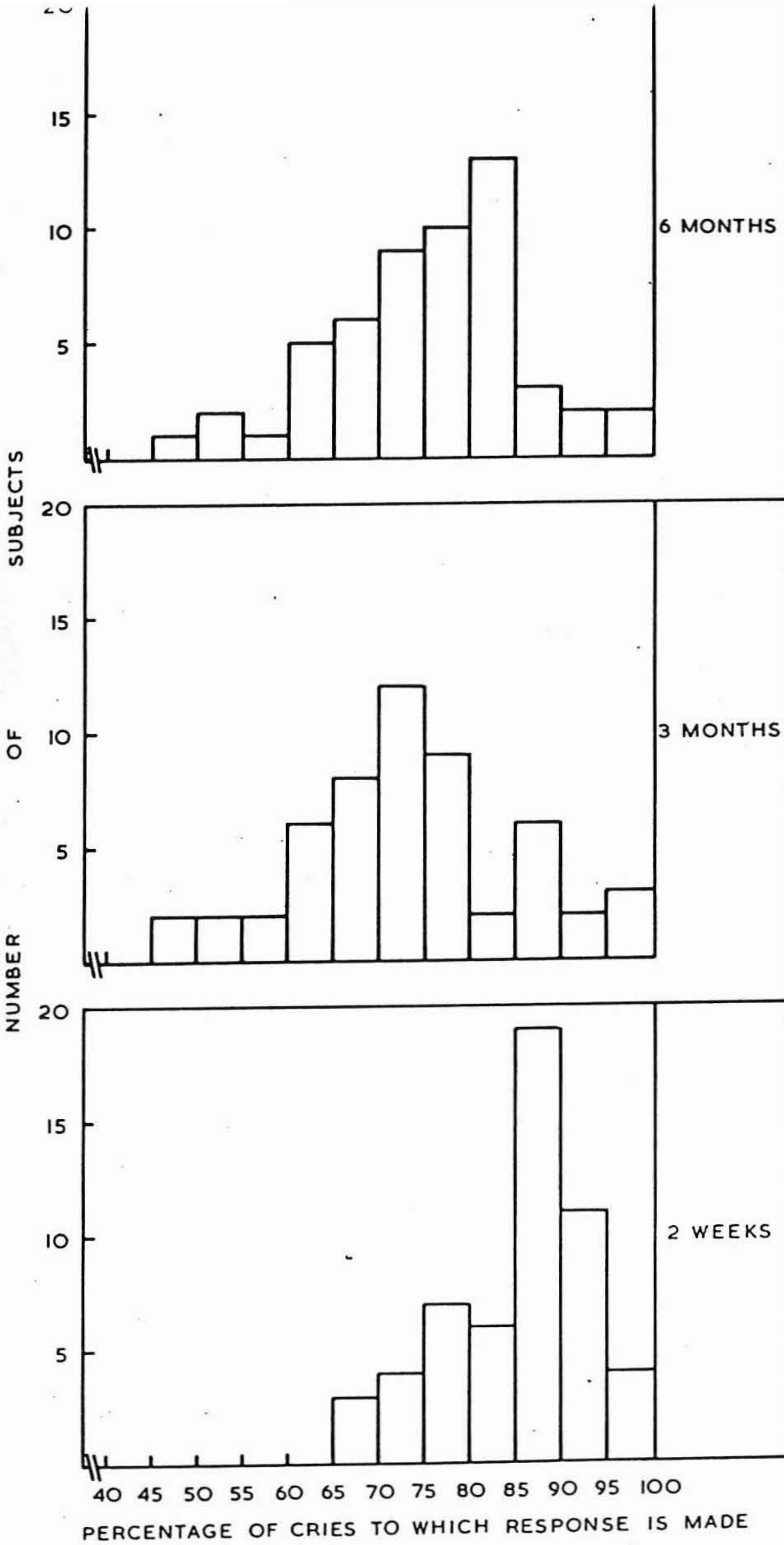


Figure 6.2: Subject distributions for percentage of cry sequences to which response is made.

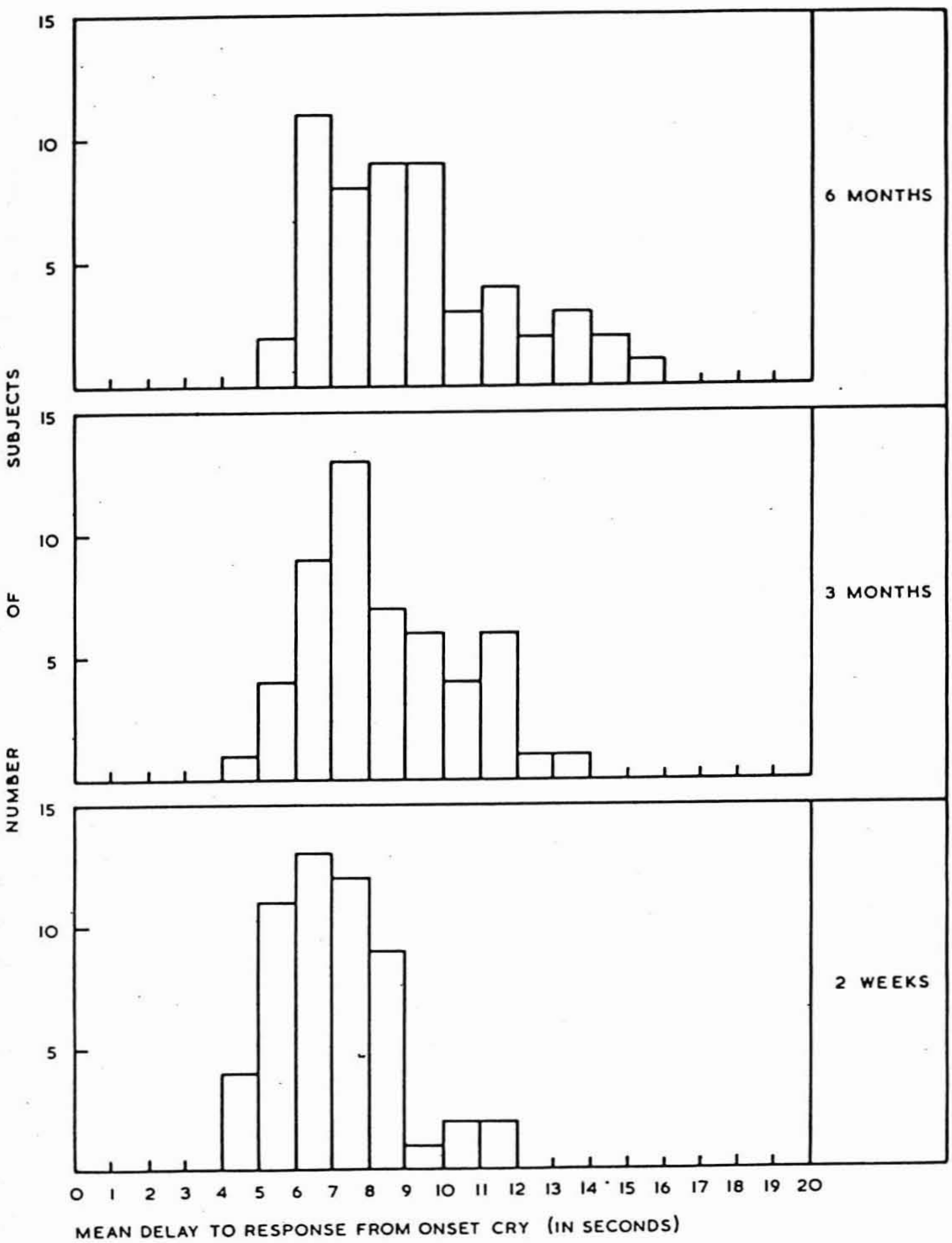


Figure 6.3: Subject distributions for mean delay from onset of cry to response.

Table 6.6: Correlations between average delay to response across age periods

Age of Infant	2 weeks	3 months	6 months
2 weeks	1.00		
3 months	0.17^{NS}	1.00	
6 months	0.21^{NS}	0.37**	1.00

NS = not significant

** = $p < .01$

*** = $p < .001$

Relationships between the two indices will be reported in a later section.

6.5 The Relationship between Maternal Attitudes to the Management of Crying, Responsiveness to Cries and Amount of Crying

Mothers were assigned separate factor scores on the basis of their responses to the items on the management of crying administered prenatally and after the six months observations. Correlations between prenatal factor scores and the percentage of cries responded to (Arcsin transformed) and mean response latencies at each observation are given in Table 6.7.

Only at two weeks was there any significant association between mothers' attitudes to crying and their behaviour in response to crying. Those with high factor scores (indicating a "permissive" attitude to the management of crying) were more likely to respond to cries and delayed least in responding, as indicated by the negative correlation between attitudes and delay.

Correlations between infants' hourly rates of crying at each observation and mothers' factor scores at six months are given in Table 6.8. All the correlations

Table 6.7: Correlations between prenatal attitude factor scores and maternal responsiveness indicated by percentage of cries responded to and mean response latency.

		Prenatal factor score
2 weeks	% response	.39**
	$\bar{X}$ response latency	-.46**
3 months	% response	$.11^{NS}$
	$\bar{X}$ response latency	$-.07^{NS}$
6 months	% response	$.06^{NS}$
	$\bar{X}$ response latency	$.14^{NS}$

NS = not significant

** = $p < .01$

Table 6.8: Correlations between infant hourly crying rates and maternal attitude factor scores at six months.

	Hourly rates crying		
	2 weeks	3 months	6 months
Maternal attitude factor scores	-.66**	-.42**	-.47**

** $p < .01$

were significant and negative indicating that mothers whose infants showed high rates of crying over the first six months tended to develop less 'permissive' attitudes than those whose infants cried relatively little.

6.6 The Nature of Responses to Cries

The nature of responses to cries was analysed for each of the fuss-cry events outlined earlier (Figure 5). If this procedure is not adopted then lag analysis of maternal events conditional on the event "fuss", for example, would be contaminated by responses which may have been made to subsequent cries. In addition, it might be expected that maternal responses to each of these four classes of events would differ. A single isolated instance of fussing, for example, might be responded to quite differently from a fuss which rapidly developed into a full-blown cry.

In each of the four cases, an event lag analysis was conducted using the initial event, whether fuss or cry, as the criterion event and checking for significantly conditional maternal behaviours. Using the onset of each of these sequences as a starting point, a leading edge analysis was conducted to determine the latency of maternal responses found to be significant. Analyses were conducted separately for each of the three observation periods: two weeks, three months and six months. Results are summarized in Table 6.9.

Examination of Table 6.9 shows that at two weeks mothers reacted to fussing by approaching the infant, presumably to ascertain the infant's state and to be ready for further intervention if the fussing persisted. Only in the context of feeding, when the mother was likely to adjust or stimulate the infant, was any more direct intervention obvious. However, when the fuss developed into a full-blown cry, the lag analysis shows that mothers responded in a variety of ways which seemed to be designed to soothe the crying infant. If a mother was holding her infant then she was likely to adjust that hold, usually placing the infant against her shoulder. If not holding the infant, then fuss-cry episodes resulted in her picking up the infant more often than expected from

Table 6.9: Maternal events significantly conditional on fussing and crying at two weeks, three months and six months.

Age of Infant	Criterion Event	Significant Events	Lag (up to lag 10)	Latency (in seconds)
2 weeks	Fuss alone	Approaches	1	6
		Adjusts/stimulates feed	3	7
	Cry alone*			
	Sequence beginning fuss	Approaches	1	5
		Adjust/stimulates feed	4	6
		Adjusts hold	4	7
		Picks up	6	11
		Rocks	8	16
		Feeds	9	27
	Sequence beginning cry	Approaches	1	4
		Picks up	3	5
		Affectionate physical contact	6	11

(continued)

Table 6.9 (continued)

Age of Infant	Criterion Event	Significant Events	Lag (up to lag 10)	Latency (in seconds)
3 months	Fuss alone	Adjusts hold	3	8
		Rocks		13
	Cry Alone*			
	Sequence beginning fuss	Adjusts hold	3	9
		Picks up	5	15
		Feeds	8	27
		Rocks	10	29
		Walks	10	36
	Sequence beginning cry	Approaches	1	4
		Picks up	4	9
		Rocks	7	15

(continued)

Table 6.9 (continued)

Age of Infant	Criterion Event	Significant Events	Lag (up to lag 10)	Latency (in seconds)
6 months	Fuss alone	Approaches	3	12
		Offers toy/object	7	16
		Plays, entertains	9	21
	Cry alone*			
	Sequence beginning fuss	Offers toy/object	4	10
		Plays, entertains	7	19
		Picks up	8	26
		Feeds	10	67
	Sequence beginning cry	Approaches	1	5
		Picks up	3	8
		Affectionate physical contact	6	12

* Too few instances to permit analysis.

the unconditional probability of that behavior. Similarly, although with much longer latency, rocking and feeding occurred more frequently in response to fuss-cry sequences than would be expected from their unconditional probabilities. If the infant launched suddenly into a full-blown cry at this age, the mother responded promptly, approaching the infant if she was not nearby and/or picking up the child and engaging in affectionate physical contact.

At three months, her responses were very similar, although latency to respond was longer than at two weeks for fusses alone or for sequences beginning with a fuss. Similar soothing techniques were used for both these classes of event, although the adjustment or stimulation of feeding was no longer a contingent event. Sequences beginning with a cry were still responded to promptly and were likely to result in the infant being picked up, held and rocked.

At six months, the repertoire of maternal responses seemed more restricted and the type of responses made to fusses and fuss/cry sequences were clearly different from those used at two weeks and three months. Mothers were most likely to attempt to distract infants by offering them toys or playing with them. However, the pattern of response to sequences beginning with a cry remained virtually unchanged and mothers still responded with alacrity to these events.

6.7 Aversive Responses to Cries

In all the observations only two instances of genuinely punitive responses to cries were seen. In both cases the mothers hit their six month old (male) infants, but not with great force. This was accompanied in both instances by critical comment ("disapproves"). Disapproval was, in fact, a relatively common feature of mothers' responses to fuss-cry sequences, especially for the older infant. Thirteen per cent of these sequences in the six month old infants were accompanied by disapproving comments and ten per cent by negative commands such as "stop that crying", although lag sequential analysis shows that these events were no more likely to occur in response to fuss-cry sequences than to other infant behaviours. When fuss-cry sequences which began during mother-infant interaction are analysed separately, it is evident that mothers occasionally broke off interaction with their infants when crying commenced as indicated by the categories "puts down" and "moves away". This tendency was more pronounced for the older infant (Table 6.10), and the termination of interaction more rapidly accomplished.

Table 6.10: Events conditional on cry sequences which begin during mother-infant interaction.

Age of Infant	Event	Lag	Latency (in seconds)
2 weeks	adjusts/ stimulates feed	2	3
	Burps	4	6
	Rocks	4	17
3 months	Rocks	6	29
	Puts down	9	64
6 months	Puts down	2	33
	Moves away	4	39

6.8 Maternal Response Related to Events Preceding Cry Sequences

Table 6.11 shows the relationship between the events found to precede cry sequences and the frequency, promptness and nature of maternal response.

At two weeks, mothers clearly tailored the nature of their interventions to the nature of the events apparently precipitating the fusses or cries. The predictability and promptness of their responses was also clearly determined by the nature of these stimuli. For example, fussing or crying which followed the interruption of feeding frequently obtained a prompt response from mothers and was most likely to result in the resumption of feeding. Similarly, if infants began to fuss or cry on the terminations of rocking, event lag analysis shows that rocking was more likely to follow such cries than would be predicted from the unconditional probability of this event. Infants who cried upon loss of physical contact (M puts down I) were likely to be ignored on 20% of occasions, although the latency of response when one was given, was relatively short. Furthermore, event lag analysis also shows that picking up was more common in this situation than would be expected from its occurrence in the data as a whole.

The most obvious changes at three months are those related to the proximity of the mother. Cries preceded by being put down or by the mother moving out of contact were more likely to be ignored altogether, and the latency to response, when one occurred, was relatively long. Nonetheless, the nature of the responses made were clearly related to the preceding events. Mothers approached and/or picked up infants when they did respond, but were also likely to attempt to distract infants from crying by playing with them.

By six months, there was a much less obvious connection between events preceding cries and the nature

Table 6.11: Relationship between behaviours preceding cry sequences and frequency, promptness and nature of maternal response.

Age of Infant	Behav- iour Preceding Cry Sequence	% response	Latency to Response	Nature of Response*
2 weeks	M. interrupts feed	92	4.6	Feeds
	I. moves	61	12.6	-
	M. puts down I.	79	8.4	Picks up, rocks
	I. avoids feed	86	6.2	Burps
	Termination rocking	96	4.9	Rocks
3 months	M. restrains/prohibits	72	9.6	-
	M. general caretaking	64	10.0	-
	M. interrupts feed	89	4.9	Feeds
	I. frowns	62	13.2	M. picks up I.
	M. puts down I.	57	12.4	M. picks up I.
	I. crash	96	4.1	-
	M. moves away	69	11.1	M. approaches
				Plays/entertains
6 months	M. moves away	59	16.2	M. approaches
	M. puts down I.	52	13.9	-
	M. restrains/prohibits	71	11.4	-
	M. general caretaking	79	9.5	Plays/entertains
	I. crash	94	4.7	Picks up

* Determined from event lag analysis using fusses and cries preceded by events indicated in column 1 as criterion events.

of maternal response. While mothers were still likely to approach infants who cried on their departure, there was a longer latency to response and no consistent relationship between cries precipitated by mothers putting down infants and the type of response made. Indeed a large proportion of such cries were ignored altogether (48%). Obvious hurt to the infant (crash) was still attended to promptly, usually by picking up the infant.

6.9 Effectiveness of Responses

As indicated in the discussion in Chapter 3 on measurement of maternal responses to cries, it is not possible to derive an independent index of effectiveness in terminating cries. Measuring effectiveness by simply computing the time it takes for the baby to stop crying after a particular maternal intervention has several inherent problems. In the first place, it is also a measure of the infant's consolability, the ease with which the infant can be quieted. In addition, it is likely to depend on the point of any crying sequence at which a response is made. For example, if the mother responds soon after the onset of a low intensity fuss, it is possible that she will be more successful in terminating the cry than if she delays until the cry has reached high levels of amplitude and density. Furthermore, the decision about when a cry has terminated must be arbitrary. For example, one infant may stop crying but only for a few seconds while another may remain quiet for several minutes or more. Bell and Ainsworth (1972) deemed a cry successfully terminated if the baby remained quiet for more than two minutes after intervention, but other decision rules are obviously possible.

Despite these problems, an attempt is made to characterize responses in terms of their effectiveness in terminating cries. It is possible from group results to examine each category of response in terms of its overall level of success in terminating cries. Since, in many cases, several responses may be employed before crying is terminated, a response is considered successful only when it is concurrent with or immediately prior to the cessation of crying. A cry is considered terminated if more than one minute of other infant activity follows before further crying. The duration from the onset of each response to the cessation of crying is computed for those occasions when it is successful. In addition, the value of the response in preventing further crying is measured by calculating the duration of non-crying activity following the termination of that response. This is important because some responses, such as holding and rocking may inhibit crying for as long as they are continued, but upon their cessation crying may be rapidly resumed.

In some instances responses, sometimes by definition, occur in conjunction with others. For example, feeding for the two week old, is universally accomplished while holding the infant. Similarly, rocking and walking while sometimes undertaken using mechanical devices such as rockers or prams are typically carried out in the mother's arms, particularly for the younger infant. To ascertain the importance of close physical contact in quieting the crying infant, responses are analyzed under two conditions: (a) when they are undertaken while holding the infant, and (b) when the infant is not being held. Figure 6 .4 indicates for each response found to be contingent on crying the percentage of those occasions on which it was employed that cessation of crying resulted, as well as the duration (in seconds) from the onset of the response to termination of crying. In addition the duration (in minutes) of non-crying activity following termination of the response is given. Data are presented separately for each age period.

At two weeks, the response most effective in quieting the crying infant was feeding. Since most of the mothers in the sample were breast feeding, close body contact was an integral part of this response. Cessation

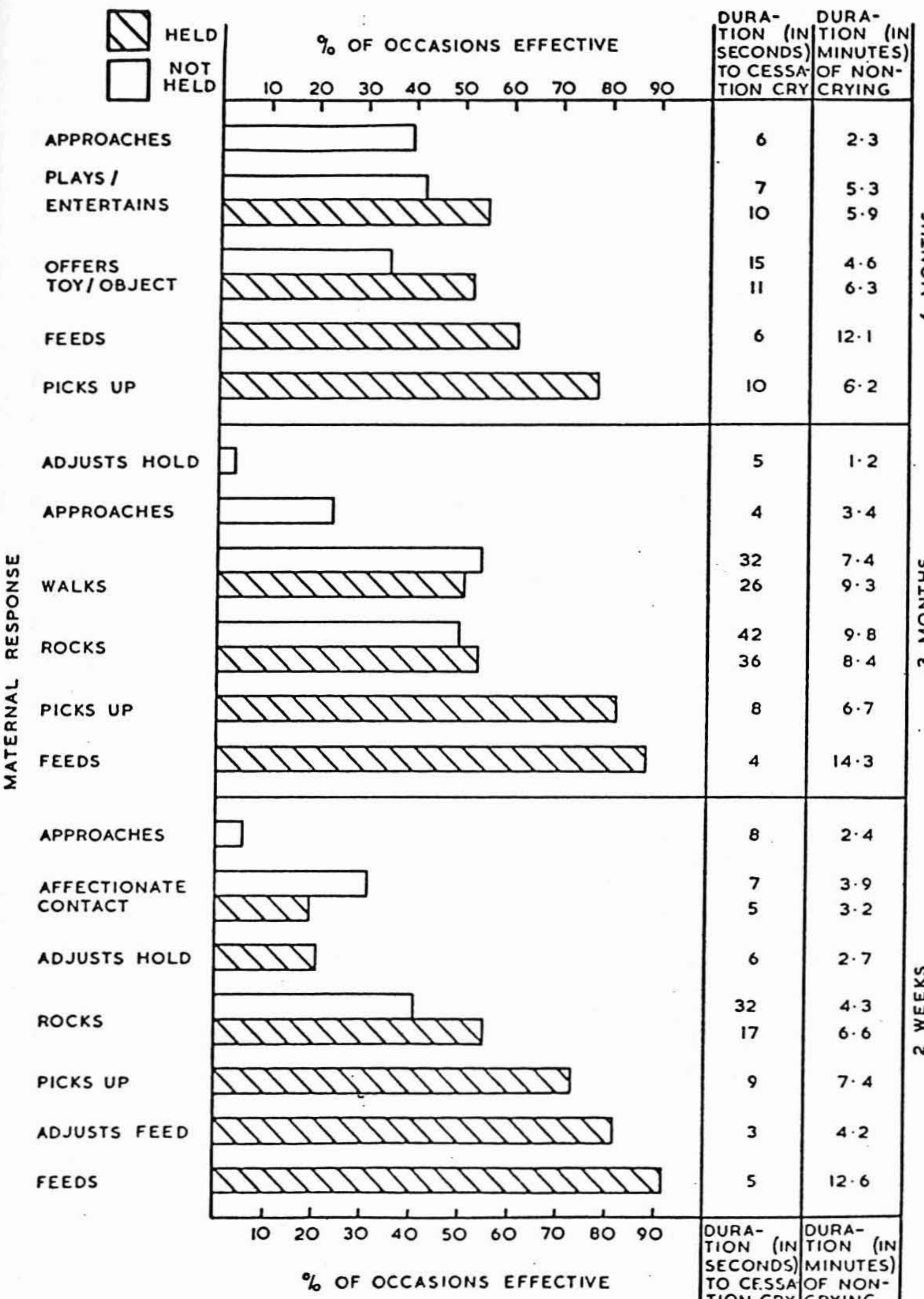


FIGURE 6.4: Effectiveness of responses in terminating cries measured by % occasions effective, duration to cessation cry and duration of subsequent non-crying activity.

of crying was, of necessity, accomplished rapidly, since infants cannot easily cry once a nipple has been inserted into the mouth. Feeding was also the response most likely to delay further crying. In the present study, adjusting or stimulating feeding was also a highly successful response at two weeks and typically occurred when infants fussed briefly while feeding, apparently as a result of discomfort or difficulty in feeding. Termination of crying was usually accomplished rapidly. Picking up and holding the infant was (on 75% of the occasions it was employed) rapidly successful in quieting the crying infant, although this success was more transient than for feeding. When rocking was employed in response to crying, it took longer to terminate the cry than either feeding or picking up and was most successful when close body contact was involved. Other responses were only occasionally and briefly successful.

The pattern at three months was slightly different. Although feeding was still the most successful response, picking up and holding the infant was equally likely to result in the termination of crying, although success was, again, relatively short-lived compared with feeding. Rocking and walking up and down were somewhat less successful than picking up and feeding and at three months it apparently made little difference whether body contact was involved or not. In both cases, a relatively long time was required to quiet the infant, although the duration of subsequent non-crying activity shows these responses to be generally more successful than simply picking up the infant.

At six months, simply being picked up was the most successful intervention, and it prevented further crying for longer than at the two previous ages, even when the infant was put down again. Offering toys and playing with the infant were also reasonably effective responses, the more so if close body contact with the mother was involved. Simply approaching the infant was also successful on the 40% of occasions it occurred although the effect was transient if no other response was forthcoming.

6.10 The Relationship Between Events which Precede Fuss-Cry Events and the Effectiveness of Maternal Responses

As indicated in the section on infant crying, several maternal and infant behaviours can be identified by lag analysis as predictable antecedents of fuss-cry events. It has also been shown in Section 6.8 that mothers tailor their responses according to the nature of these antecedents. Results presented below (Table 6.12) show the relationship between fuss-cry events with these antecedents and the effectiveness of responses the mothers make. All responses except clearly aversive ones are examined. Effectiveness is measured by the proportion of occasions a given response is successful in terminating fuss-cry events preceded by the events indicated in column 1 of Table 6.12. Only the most successful response for each category is reported here.

There is a systematic relationship between the events preceding fuss-cry events and the nature of the most effective soothing techniques when infants are two weeks old. Crying elicited by interruption of feeding was most likely to be soothed by the resumption of feeding. Similarly, picking up the infant was the most successful of the responses for cries preceded by loss of physical contact with the mother. In addition, rocking, following cries occasioned by the termination of rocking, was the most efficacious of the mother's responses in this situation.

At three months, distracting the infants, by offering toys or playing with them, was the most successful strategy for terminating fuss-cry events preceded by restraint or prohibition of the infants' activities or when infants were clearly hurt. Feeding was still the response most

Table 6.12: Relationship between events preceding fuss-cry events and the most successful maternal responses.

Age of Infant	Preceding Event	Most Successful Response
2 weeks	M. interrupts feed	Feeds (94%)
	I. moves	Picks up (72%)
	M. puts down I.	Picks up (86%)
	I. avoids feed	Rocks (43%)
	Termination rocking	Rocks (69%)
3 months	M. restrains/ prohibits	Offers toy/object (42%)
	M. general caretaking	Plays/entertains (61%)
	M. interrupts feed	Feeds (93%)
	I. frowns	Picks up (72%)
	M. puts down I.	Picks up (83%)
	I. crash	Picks up (74%)
	M. moves away	M. approaches (49%)
6 months	M. moves away	Approaches (74%)
	M. puts down I.	Plays/entertains (65%)
	M. restrains/ prohibits.	Offers toy/object (70%)
	M. general caretaking	Plays/entertains (81%)
	I. crash	Plays/entertains (43%)

likely to succeed when attempting to quiet infants who cried upon interruption of feeding, and picking up the infant was also the most successful response when being put down preceded the fuss-cry event. Similarly, the mother's return to the infant's visual field was most successful for fuss-cry events precipitated by her moving away.

By six months the relationships between the preceding events and the most effective responses were less direct and the most successful responses were predominantly those involving distraction (offers toy/object; plays/entertains). While approaching the infant who cried when the mother moved away was still the most successful response for that class of fuss-cry events, playing with the infant who cried upon loss of physical contact was more effective than picking up and holding. Playing was also the most effective response when infants cried as a result of being hurt (crash).

6.11 Relationships between Indices of Maternal Responsiveness

Before concluding this section the relationship between various attributes of maternal response will be examined. As indicated in Chapter 3, a number of writers (for example Bell and Ainsworth, 1972) have argued that there is a general dimension of maternal responsiveness which is critical in determining both changes in crying and the developmental course of the mother-infant relationship. It was also pointed out that several of the attributes of maternal response to crying, particularly response latency and effectiveness in terminating cries, are confounded with measures of infant crying. For this reason it was judged necessary to exclude them when conducting the causal modelling procedures necessary to untangle the direction of effects in longitudinal change. Nonetheless, it is important to establish how these variables are related to the measure used in that analysis (proportion of cry sequences to which response is made). Furthermore, apart from responses typically made in response to cries, mothers vary in the proportion of available time they spend in interaction with their infants, as well as in the quality of that interaction. It is essential to determine whether these attributes are related in any systematic way to the variable entered into the models described (Chapter 3).

In measuring interaction time it is obviously important to exclude the amount of time the infant spends crying, since this in part, determines the measures of response latency and effectiveness in terminating cries with which the interaction measure is to be correlated. Since coding ceased if infants fell asleep, it is not necessary to correct for sleeping time. However, the amount of time spent in feeding differed considerably between mother-infant pairs and since this is probably largely a function of the time since the last feed it is also excluded when evaluating the time available for interaction. The interaction time measure is thus the proportion of observation time (excluding feeding and crying time) during which the mother is interacting with the infant.

Figure 6.5 shows the proportion of available time mothers spent in interaction with their infants at each of the three observation periods. The apparent increase in this index suggested by the figure was confirmed by analysis of variance of the Arcsin transformed percentages. There was a clear age effect ($F = 5.62$; $df = 2,104$; $p < .01$) and a sex x age interaction ($F = 6.91$; $df = 2,104$; $p < .01$) which seems to be accounted for by the fact that at six months mothers of males spent less time in interaction with their infants than mothers with females.

Determining the quality of such interaction is clearly more complex. A number of studies of mother-infant interaction have attempted to address this question (e.g. Klaus *et al.*, 19 ; Field, 1977), and have typically used the amount of looking, touching, holding and smiling directed toward the infant as an index of the quality of interaction. All of these essentially positive responses were coded in the present investigation, together with

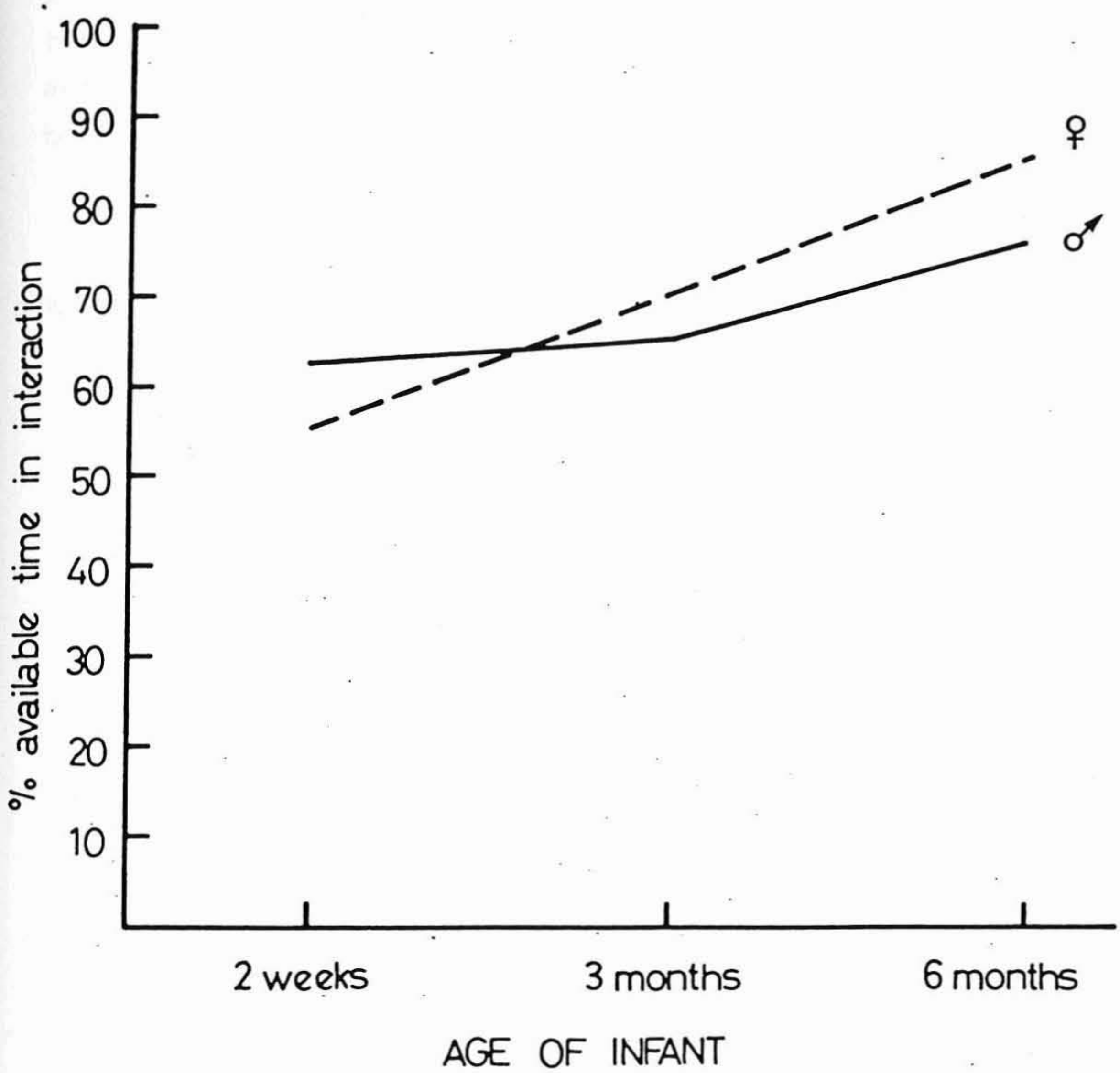


FIGURE 6.5: Percentage of available time (excluding feeding and crying time) mothers spent in interaction with male and female infants at two weeks, three months and six months.

others which appear to share the same quality (e.g. plays/ entertains, tickles, offers toy/object). A composite, if somewhat crude index of the quality of the mother's interaction with the infant can be derived by calculating the proportion of total maternal responses during interaction which are positive in nature. Responses judged to be positive are detailed in Table 6.13.

Table 6.13: Maternal behaviours entered into the measure "proportion of positive responses".

Holds toward
Holds away
Offers toy/object
Affectionate physical contact
Tickles
Smiles / Laughs
Sings
Approves
Imitates
Demonstrates
Plays / Entertains
Talks
Attends

Field (1977) has also suggested that the extent to which maternal responses occur within a given time of an infant behaviour and are similar in kind to that behaviour reflects the responsivity of the mother. Although it is prohibitive to examine all infant behaviours in terms of contingent maternal responses, examination of the probability of maternal smiling and vocalizing immediately following these same behaviours in the infant should provide a partial measure of this attribute. Looking at the infant is not considered since it has been shown to accompany most maternal behaviour exhibited during interaction sequences (Bakeman and Brown, 1977).

Table 6.14 shows the proportion of maternal responses during interaction which are positive in nature and the probability of maternal smiling and vocalising immediately following these same behaviours in the infant. Analyses of variance revealed an age effect for the first of these indices ($F = 5.82$; $df = 2,104$; $p < .01$) but not for the second. Other effects were not significant.

Table 6.14: The proportion of positive maternal responses and the probability of maternal smiling and vocalizing following these behaviours in the infant.

Age of Infant	% positive responses	Probability smile-vocalize
2 weeks	69%	.44
3 months	73%	.55
6 months	79%	.49

Table 6.15 gives the correlations between the indices of maternal response outlined above. Because of the relatively large number of correlational tests made and the possible increase in Type 1 errors, a conservative Alpha of 0.01 has been used to determine significance levels.

Since the pattern of correlations is similar over the three age periods, the results are considered as a whole. The negative correlation between indices 1 and 2, typical of each age period, indicates that mothers who responded to a high proportion of their infant's cries were also likely to respond promptly. Furthermore, at six months the index of response latency (2) was also positively correlated with the length of time it took the infant to cease crying after maternal intervention.(4) At two weeks, but not at later observations, the latter index was also clearly associated with the number of interventions which were employed before cries were terminated, indicating that mothers who took longer to terminate cries also employed more responses in order to do so.

It is significant that none of the indices of maternal responses to crying (1,2,3,4) was correlated with measures of the quantity or quality of maternal interaction with infants. (5,6,7) The latter measures, however, were themselves inter-related. Mothers who spent a high proportion of available time in interaction were also likely to direct a high proportion of positive responses toward their infants and, except at

Table 6.15: Correlations between attributes of maternal response within each observation period, where:

1. is the proportion of cry sequences to which a response is made (Arcsin transformed);
2. is mean latency to respond to crying sequences;
3. is the mean number of interventions employed per crying sequence prior to the cessation of crying;
4. is the mean duration from the first intervention to the cessation of crying;
5. is the proportion of available observation time (excluding crying and feeding) spent in interaction with the infant (Arcsin transformed);
6. is the proportion of all maternal responses during such interactions which are positive (Arcsin transformed); and
7. is the probability of like response following infant smiling and vocalizing (Arcsin transformed).

Infant's age		1	2	3	4	5	6	7
2 weeks	1	1.00						
	2	-0.67***	1.00					
	3	-0.21	0.11	1.00				
	4	-0.17	0.24	0.47***	1.00			
	5	-0.13	0.13	-0.07	-0.02	1.00		
	6	0.09	0.04	0.14	0.19	0.62***	1.00	
	7	0.14	0.21	-0.12	0.16	0.39	0.27	1.00
3 months	1	1.00						
	2	-0.53***	1.00					
	3	-0.14	0.23	1.00				
	4	-0.19	0.31	0.21	1.00			
	5	0.06	0.16	0.14	0.07	1.00		
	6	0.17	-0.11	0.09	0.13	0.54***	1.00	
	7	-0.12	0.19	0.04	0.23	0.47***	0.36**	1.00
6 months	1	1.00						
	2	-0.69***	1.00					
	3	-0.21	0.19	1.00				
	4	-0.17	0.35**	0.26	1.00			
	5	0.04	0.16	0.19	0.14	1.00		
	6	0.16	0.10	-0.04	0.12	0.67***	1.00	
	7	0.23	0.26	0.07	0.16	0.42**	0.46**	1.00

** $p < .01$
*** $p < .001$

two weeks, these two variables also correlated with 7, the probability of like response following infant smiling and vocalizing.

The clear implication of these findings is that maternal responses to cries are not related to aspects of maternal responsiveness defined by the quantity and quality of interaction.

6.12 Summary of Results

As a group, the mothers investigated had permissive attitudes toward the management of crying when questioned before the birth of their infants. By six months, however, there was a relatively uniform and fairly pronounced shift toward less permissive attitudes. For example, mothers had initially indicated that they believed ignoring cries would make the infants cry even more, but later came to reverse this position.

This change was also evident in their behaviour over the six months of observation. Indices of both maternal delay in responding and the proportion of cries to which mothers responded showed significant shifts toward lowered responsiveness. As the infants matured, mothers ignored more cries and delayed longer in responding. Furthermore the nature of the fuss-cry event affected both these measures of response. Sequences beginning with a cry rather than a fuss, were not only more likely to obtain a response but were also responded to with alacrity. There was little change in this pattern over the six months. Responses to sequences beginning with a fuss showed more change over the period of observation. Mothers delayed longer and responded to a smaller proportion of these events over time.

Only in latency to respond to cries was any sex-differentiated maternal behaviour detected. At six months, mothers of males delayed longer in responding to cries than mothers of females.

While the mothers studied were at first remarkably homogeneous with respect to delay in responding and the proportion of cries to which they responded, the distributions for these indices showed increasing dispersion over the six months. Mothers who delayed longest were also those who ignored the greatest proportion of cries. These variables were not, however, related to measures of the quality and quantity of interaction outside that accompanying infant crying.

Lag analysis of maternal behaviours conditional on infant fussing and crying showed several predictable maternal responses which were not, however, uniquely related to the nature of the fuss-cry event. At two weeks, these responses were primarily those involving close body contact, a pattern which was still evident at three months. The major change at six months, was the greater predominance of play and the offer of toys or other objects in response to infant fussing and crying. Aversive responses to cries were only infrequently observed, although mothers, especially with older infants, were found to occasionally break off interaction if crying commenced during such interaction.

There were also clear associations between the events preceding cry sequences and the frequency, promptness and nature of maternal response. Especially at two weeks, mothers tailored the nature of their interventions to the events apparently precipitating cries. For instance, if the infant cried upon being put down, the mother was most likely to respond by picking up the infant. In addition, the likelihood and promptness of response depended on the nature of the precipitant. At six months, for example, infants who cried upon being put down were relatively unlikely to obtain a prompt response compared with occasions when the cry was preceded by clear hurt to the infant.

Analysis of individual responses revealed clear differences in effectiveness as measured by the proportion of occasions a given response was successful in terminating cries, the duration to effect termination of the cry and the duration of non-crying activity subsequent to termination of the response. Both picking up and feeding were consistently the most successful responses over the three ages, although feeding was more effective in preventing further crying. Rhythmical stimulation, by rocking and walking was also relatively successful, although termination of crying took longer to achieve. At six months, playing and offering toys were also moderately successful interventions. Each of these responses was most successful when clearly related to the event preceding the cry. Picking up, for example, was most successful when the infant cried after being put down or upon movement of the mother away from the infant's visual field. This relationship between precipitating events and most successful response was less pronounced at six months, when playing and offering toys were generally the most efficacious responses regardless of the nature of the events preceding cries.

B: Maternal Responses to Cries

6.13 Responsiveness to Cries

Mothers studied in this investigation were initially very responsive to cries, responding to more than 80% of cry sequences at two weeks, with an average latency of six to seven seconds when they did respond. This behaviour was consistent with views they expressed before the birth of their infants, when they indicated that babies' cries should not be ignored for too long since this strategy would actually increase the amount of crying in the long term.

By six months, both their behaviour and their attitudes had changed. They no longer believed that ignoring cries was harmful since they felt that some cries were simply attention getting and could be ignored. Thirt-four per cent of cry sequences were actually ignored altogether and the average delay in responding when mothers did respond was significantly greater than at two weeks. In addition, there were significant inverse correlations between the proportion of cries responded to and delay in responding, indicating that mothers who showed the lowest percentage of response to cries also delayed longest in responding.

The apparently high level of responsiveness indicated by the mean delay to response requires further comment since it seems to reflect a pattern of prompt responding not evident in other studies. The comparable item in Bell and Ainsworth's (1972) study, duration of maternal unresponsiveness to cries, was calculated by measuring the length of time babies cried without obtaining a response from the mother. It included occasions when cries were ignored altogether, except when corrections were employed for correlations within each three month period. However, in the present study duration to respond was measured only for those cries where a response was made. In addition, Bell and Ainsworth's index of duration of maternal unresponsiveness is difficult to interpret since it is reported as minutes per hour: 3.83 minutes per hour in the first quarter and 2.13 minutes per hour in the fourth. They do not make clear whether the denominator refers to hours of observation or hours of crying. If the latter is intended, then their notes are roughly comparable with those obtained in the present study, at least at three months. Calculation of the mean number of minutes per hour of infant crying during which mothers were not responding in this study produced estimates of 1.13, 3.12 and 3.65 minutes at two weeks, three months and six months respectively. No other data are available in a form to permit direct comparison.

The finding of a decline in responsiveness from initially high levels is the reverse of that reported by Bell and Ainsworth (1972). They found that, on average, mothers in their study responded to 46% of cries in the first three months with the rate rising to 63% by 12 months. They also found that maternal delay in responding diminished between the first and fourth quarters.

The discrepancy between the present findings and those of Bell and Ainsworth (1972) in the initial level of responsiveness characteristic of the two sampled groups requires further comment. Mothers in this study began at very high levels of responsiveness compared with those in Bell and Ainsworth's study and the range across subjects was also relatively narrow. This initial difference may have been an accident of sampling or a result of cultural and historical differences between the samples. Bell and Ainsworth's subjects were comparable in that they were white, middle-class and from intact families. However they were mixed in parity and no information was provided on age levels or delivery variables which might have affected maternal attitudes and behaviour. One mother ignored 97% of cries which could either mean that the child cried only very infrequently or that the mother was pathologically unresponsive. Such extreme levels of unresponsiveness were not evident in this study, probably because mothers were deliberately selected to ensure that they were not "at risk" for disturbance in mothering behaviour.

There may also have been changes in child rearing practices and philosophies since the period when Bell and Ainsworth's subjects were recruited. Certainly mothers in the present study began with "permissive" attitudes to the management of crying and all had read child care manuals published in the mid-70s which advocated such an approach. Indeed, Bell and Ainsworth's own work may have been partly responsible for the high levels of initial responsiveness characteristic of women in this study, since the contemporary manuals frequently cite the Bell and Ainsworth findings as justification for advising mothers to respond frequently and promptly to cries (Leach, 1975).

Although there are clearly likely to be cultural and historical differences in maternal management of crying (Konner, 1972; Mead and Newton, 1967), a close reading of the arguments of attachment theorists, particularly those regarding the role of crying and the mutual adaptation between mother and infant behaviour, would not lead one to expect the high levels of initial unresponsiveness apparently evident in the Bell and Ainsworth study. Ainsworth, for example, has argued that infant crying is adapted to the prototype of the responsive caregiver, "a mother who is continuously nearby and who is responsive to the infants' signals" (Ainsworth *et al.*, 1978, p. 55). Furthermore she, like Bowlby, has argued that this "behavioural system", since it is central to the care and protection of the relatively helpless and undeveloped newborn, should appear in much the same form in all members of a given species despite wide variations in their environments.

The relatively high levels of initial responsiveness, typical of mothers in the present investigation, seem compatible with this view. Bell and Ainsworth's (1972) results, however, do not appear to offer strong support for this position, although the authors ignored this apparent contradiction between their results and predictions from the evolutionary argument. They also failed to account for the improvement in maternal responsiveness as the infants matured. The decline evident in the present study which will be discussed further in later sections, seems to reflect a more reasonable sequence. Mothers, particularly inexperienced ones, might be inclined to treat all cries in the very young infant as emergency signals requiring immediate attention. As the infants mature and use other means of communication and as mothers gain more experience, particularly in judging the urgency of the infants' signals, one might expect that they would become less, rather than more responsive. Indeed, examination of responses to the four categories of fuss-cry event described in Chapter 3 indicates that fusses and sequences beginning with a fuss showed the sharpest decline, while sequences beginning with a cry were responded to uniformly and promptly across the three age periods. In the former case mothers may have learned that fusses, unlike sudden full-blown cries were not usually preceded by hurt to the infant and could on occasion be ignored. These findings are also compatible with both Pratt's (1981) and Wolff's (1969) observations that full-blown cries which develop suddenly without the intermediate stage of fussing usually signify hurt to the infant and are responded to promptly and regularly by mothers. They are also consistent with the proposition that intensity cues, like those involved in the distinction between fussing and crying, may result in listeners making qualitative distinctions about the underlying causes of cries and responding accordingly (Murray, 1979). That the ability to make such discriminations improves with experience with infants is a well established finding in studies which have examined the ability of interested listeners to make distinctions among cry types (Sagi, 1981; Wasz-Hockert *et al.*, 1968)

6.14 Responsiveness to Other Infant Behaviour

While on average the mothers' responsiveness to cries declined over the six months, the proportion of available time (excluding feeding and crying time) they spent in interaction with their infants increased. This is not an artifact of the greater proportion of time which older infants spend in the awake state, since observations were only conducted when the infants were awake.

This increase in interaction time is to be expected, since results presented in Chapter 6 and those of Moss (1967) showed that infants exhibit increasing amounts of positive social behaviour (smiling, looking and vocalizing) as they mature. Over the six months, the infants developed more extensive repertoirs of social behaviours and became more socially responsive and perhaps, therefore, more rewarding partners in interaction. As Hinde (1979) has suggested mothers share with their infants a readiness to interact for the sake of interacting and this is facilitated as their infants become more active partners in interaction.

There were, however, no relationships between mothers' responsiveness to cries and the amount of time they spent in interaction with their infants. Nor was there any association between the proportion of positive responses mothers showed during interaction or the contingency of maternal responses on infant behaviour and their responsiveness to cries. Mothers who ignored most cries and delayed longest in responding to cries were just as likely as those who were more responsive to cries to engage their infants in interaction and to be positive and responsive within that interaction. Again this finding is at odds with Bell and Ainsworth's (1972) undocumented assertion that mothers who are most responsive to infant cries are also sensitively responsive to other signals as well. Data outlined above indicate, on the contrary, that responsiveness to cries and the tendency to engage in positive and responsive interaction with infants are relatively independent dimensions of maternal behaviour. It is not possible to cluster these behaviours together into a general characteristic called maternal "responsiveness", a conclusion also reached by Dunn (1977). Possible explanations of this finding in terms of infant crying and social behaviour will be explored further in a later section.

6.15 The Nature and Effectiveness of Maternal Responses to Cries

Lag sequential analysis enabled the specification of maternal responses contingent on fuss-cry events over the three ages and the relationship between the events preceding cries, the nature of responses and their effectiveness in terminating cries. At two weeks, regardless of the nature of the fuss-cry event, mothers were likely to approach the crying infant if they were not in proximity, presumably to ascertain possible reasons for crying and to be ready for intervention if crying persisted. When fusses developed into cries, the mother typically picked up the infant who was not being held. This response was most likely if the cry actually resulted from the infant being put down and was also the most effective response to cries precipitated in this way.

If the infant was already being held, then adjustment of the hold, rocking and feeding were all significantly more likely to occur than would be expected from their occurrence in the data record. If infants cried during feeding, then the mothers typically adjusted or stimulated the feed. As with picking up, there was a close relationship between the nature of those responses and the events preceding the cries. If infants cried on the interruption of feeding then feeding was resumed. Similarly if they cried when rocking terminated, then mothers resumed the rocking. Furthermore, these were also the most effective responses in terminating cries elicited in these ways.

A comparable pattern was evident at three months, when a similar repertoire of responses was used and there was still a close relationship between the events preceding cries and the nature of the maternal response. These "appropriate" responses were also the most effective. For example, cries preceded by the mother putting the infant down, were likely to be responded to on 57% of occasions and typically by the mother picking the infant up again. This response was also the most effective in this context.

Only at six months was there any obvious change in the type of maternal response to cries. In particular, infants at this age were more likely to be offered toys and engaged in play when they cried. In addition, the close relationships between events preceding cries and the nature of maternal response was no longer evident. Infants who cried upon being put down were not responded to in any uniform way, since no response was found to be contingent. Furthermore, the most effective response in this context was not picking the infant up again, but rather playing with or entertaining the infant. This age related change in the nature of responses to cries is consistent with Pratt's (1981) finding of a decline with age in the percentage of maternal responses (such as feeding) concerned with the infant's biological needs and a corresponding increase in 'environmental' responses such as distracting the infant.

Although infants cried upon loss of contact with the mother over the six months of the investigation, the changes in maternal response to such cries and in the most effective responses suggest that the meaning of cries preceded by this event may have changed. At two weeks and three months, the data provide support for the view that the role of crying was to promote close physical contact with the mother perhaps for its own sake. At six months, infants still cried on loss of contact, but simple resumption of contact was no longer sufficient to inhibit crying. The fact that the more active and stimulating responses involved in play were effective may suggest that the infants were crying in order to facilitate social interaction and stimulation. The need which occasioned such cries may have been the "stimulus hunger" postulated by

As already reported, the techniques of approaching and picking up the crying infant were consistently employed across the three age periods. The apparent universality of these responses provides support for the attachment theory position that the role of crying is to promote mother-infant proximity and that mothers are programmed to respond in this way. However, it is clear that although these proximity promoting responses remained an important part of the mother's repertoire of responses to cries over the six months of the investigation, there was an increasing tendency for mothers to break off interaction and to put the infant down and move away if the infant cried for lengthy periods while being held. This together with the overall decline in responsiveness and the critical comment which occasionally accompanied crying suggests that mothers sometimes experienced cries as aversive. In terms of Murray's (1979) discussion of responses to crying this may indicate that the motivation shifted to the essentially egoistic one of diminishing the mother's distress at having to listen to the sound of crying. In Tomkin's (1963) terms, the "critical toxicity" level may have been reached. Whether the tendency to ignore cries and delay in responding were systematically related to the amount of infant crying will be discussed further in a later section.

6.16 Sex Differentiated Maternal Behaviour

While there were no sex differences in any of the infant variables measured, there were two instances of sex-differentiated maternal behaviour. At six months, mothers of males delayed longer in responding to cries than mothers of females, although they responded to approximately the same proportion of cries. In addition, they spent less of the available non-crying time in interaction with their infants. Since there were no significant sex differences in either the amount of crying or social behaviour, this difference cannot be attributed to sex differences among the infants.

These findings may imply that mothers were deliberately attempting to shape their infants' behaviour toward that judged appropriate for their sex. In older infants there is a significantly higher incidence of crying among girls than among boys, a difference which increases with age (Shepherd, Oppenheim and Mitchell, 1971). The tendency of mothers of males in this study to delay in responding to cries may represent an early attempt to communicate the sex-typed standard that "little boys don't cry". Similarly, the fact that mothers of males spent less time interacting with their infants may imply that they were attempting to modify the infants' dependency on them, since dependency is a characteristic typically discouraged in male children (Maccoby and Jacklin, 1974).

This interpretation is, of necessity, highly speculative, since no data were collected on the mothers' beliefs about desirable sex standards. However, they are consistent with other studies (e.g. Bakeman and Brown, 1977; Will, Self and Datan, 1976) which have found significant differences between mothers' behaviour toward male and female infants in the absence of sex-differences in infant behaviour.

CHAPTER 7

RESULTS AND DISCUSSION III :
LONG TERM CHANGE AND THE DIRECTION OF EFFECTS

A: Results

7.1 Introduction

Results in this Chapter indicate the relationship across observations between the frequency of infant crying and the proportion of cries to which mothers respond. Correlations between these variables are first presented, together with scatterplots showing the nature of the relationships obtained. This is followed by the results of the causal modelling procedures employed, indicating the most parsimonious models for which the estimated co-variance matrices generated do not differ significantly from obtained covariances. Structural equations are also presented. The extent to which the characteristics of the data are consistent with the assumptions made in the modelling procedures is then assessed. Analysis of selected individual data, necessary for an evaluation of the Gewirtz and Boyd model, concludes the results section. The findings are then discussed in terms of the three models of the direction of effects outlined in Chapter 3. Possible reasons for discrepancies with the Bell and Ainsworth (1972) findings are discussed. The Chapter concludes with general discussion of the adequacy of the study and the implications of the major findings.

7.2 Correlations

In all analyses reported, the frequency of cry sequences for the observation sessions are indicated by FC_1 (two weeks), FC_2 (three months) and FC_3 (six months). The percentage of cries to which mothers respond in each observation session (Arcsin transformed) are indicated by PR_1 (two weeks), PR_2 (three months) and PR_3 (six months).

The relationships between the frequency of infant cries and the proportion of cries to which mothers respond between age periods are illustrated by the scatterplots given in Figures 7.1 to 7.6. Plots in Figures 7.1 to 7.3 show the relationships between infant crying at two weeks and three months and the percentage of maternal responses

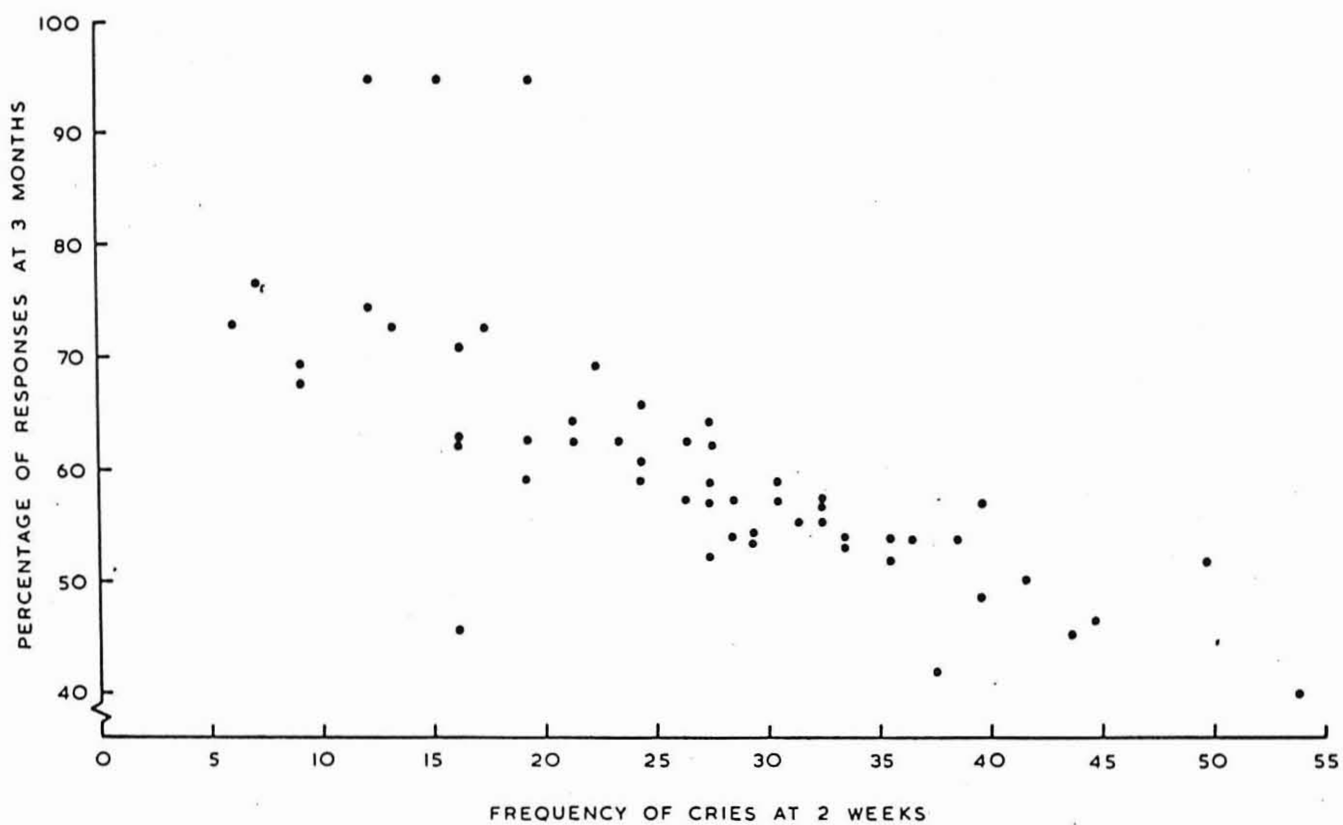


FIGURE 7.1: Scatterplot of the relationship between frequency of cries at 2 weeks and proportion of cries to which mothers respond at 3 months.

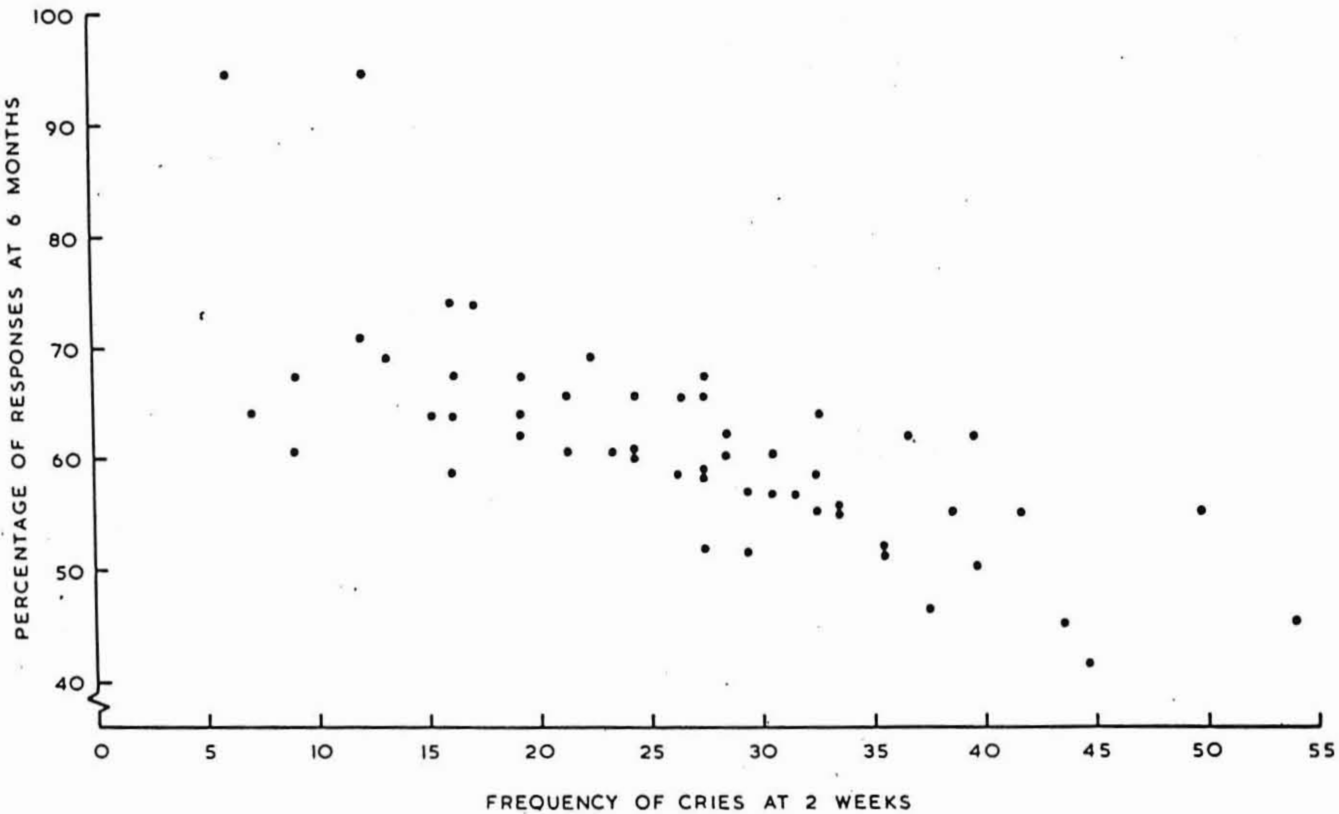


FIGURE 7.2: Scatterplot of the relationship between frequency of cries at 2 weeks and proportion of cries to which mothers respond at 6 months.

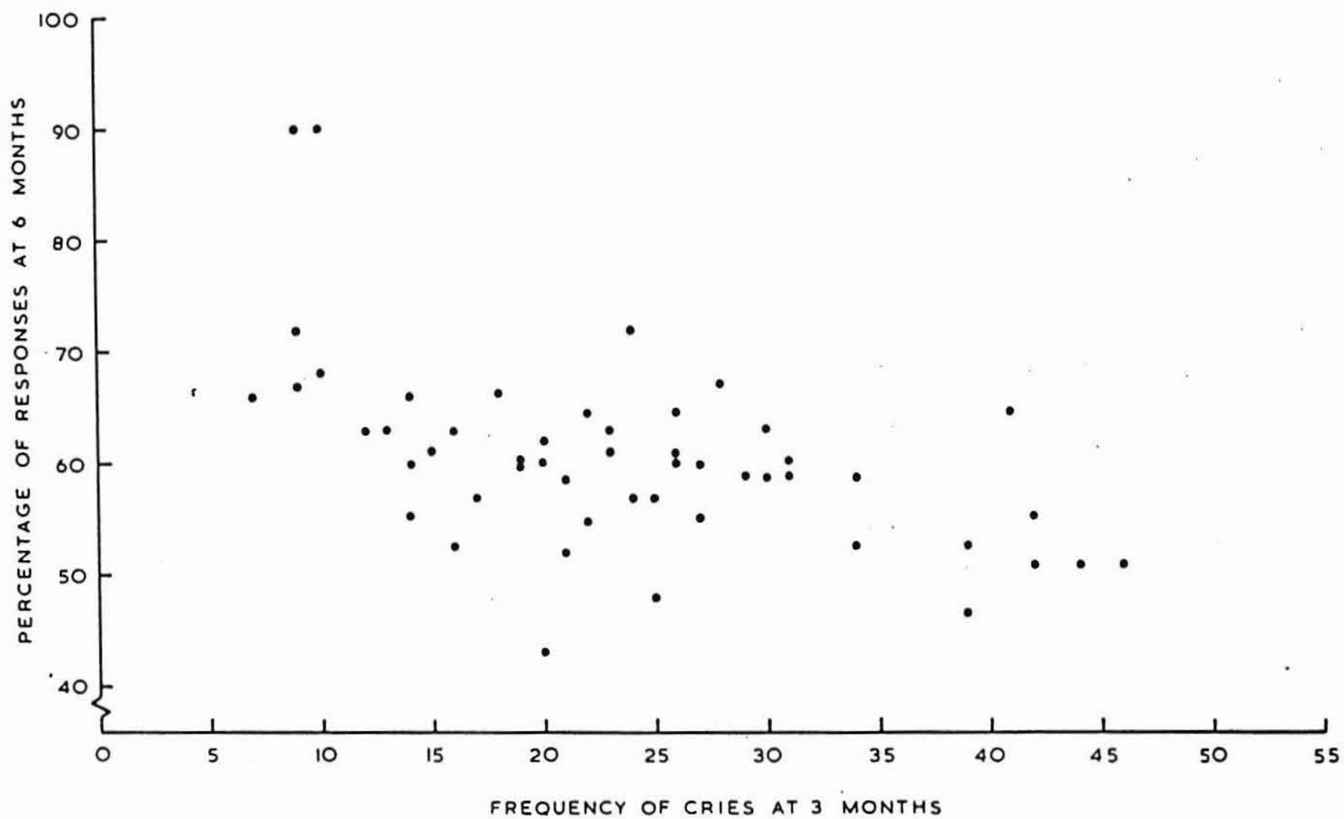


FIGURE 7.3: Scatterplot of the relationship between frequency of cries at 3 months and proportion of cries to which mothers respond at 6 months.

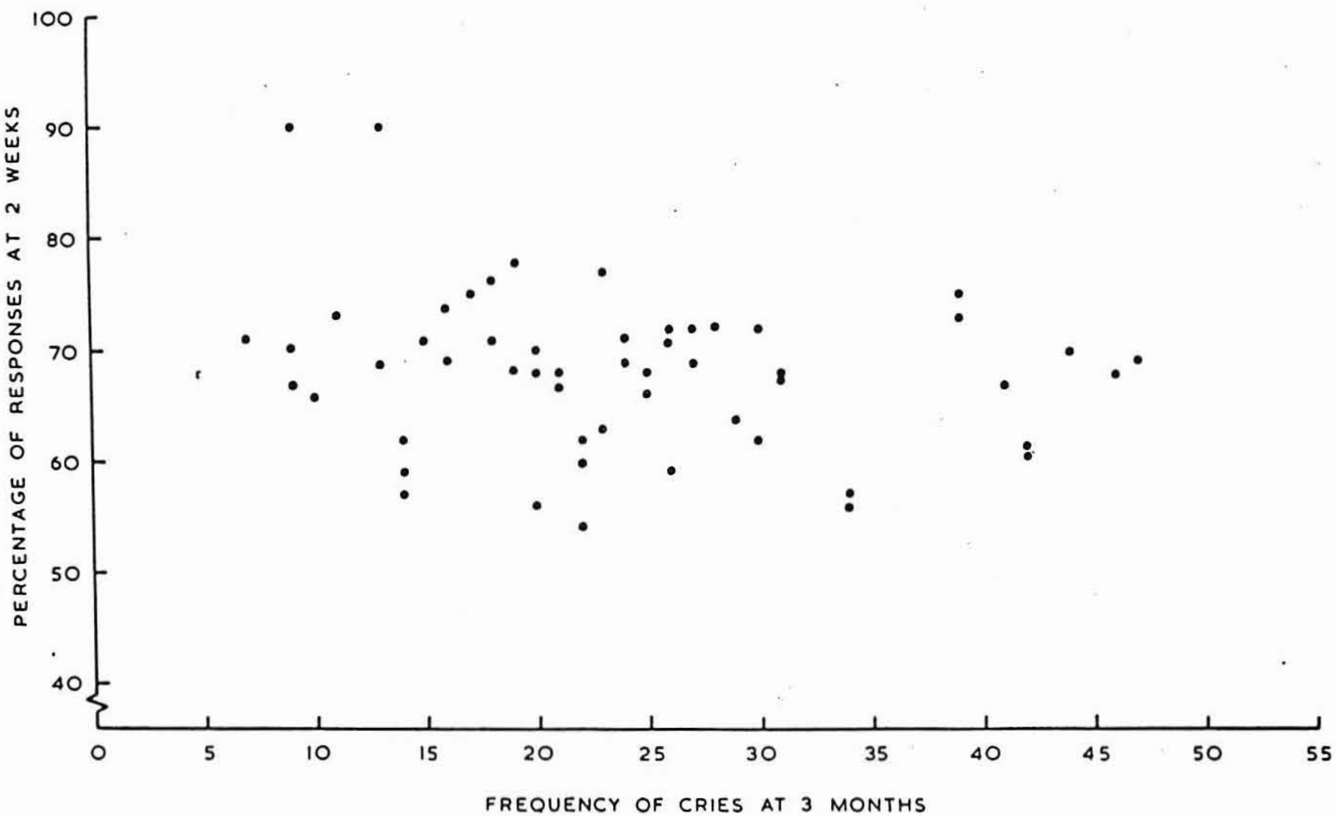


FIGURE 7.4: Scatterplot of the relationship between the proportion of cries to which mothers respond at 2 weeks and the frequency of cries at 3 months.

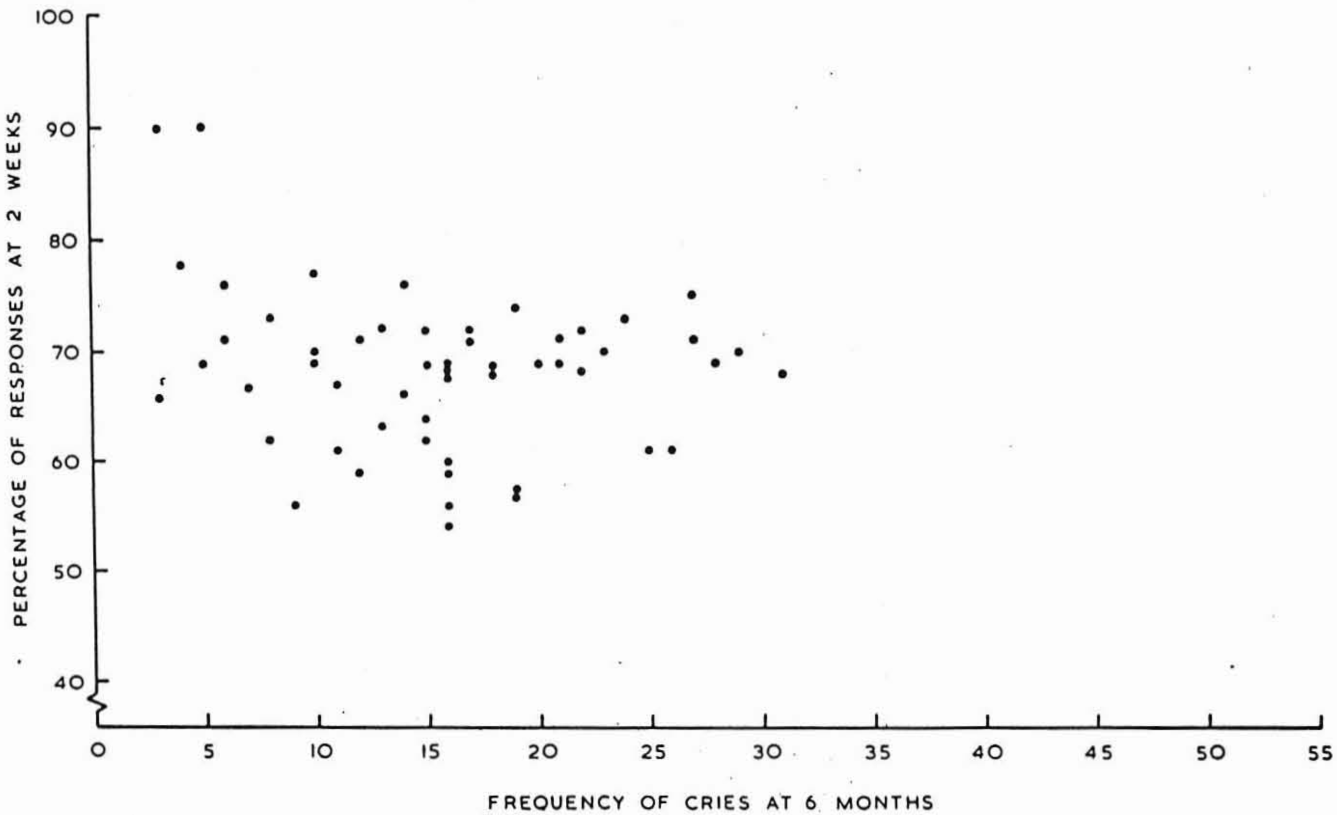


FIGURE 7.5: Scatterplot of the relationship between the proportion of cries to which mothers respond at 2 weeks and the frequency of cries at 6 months.

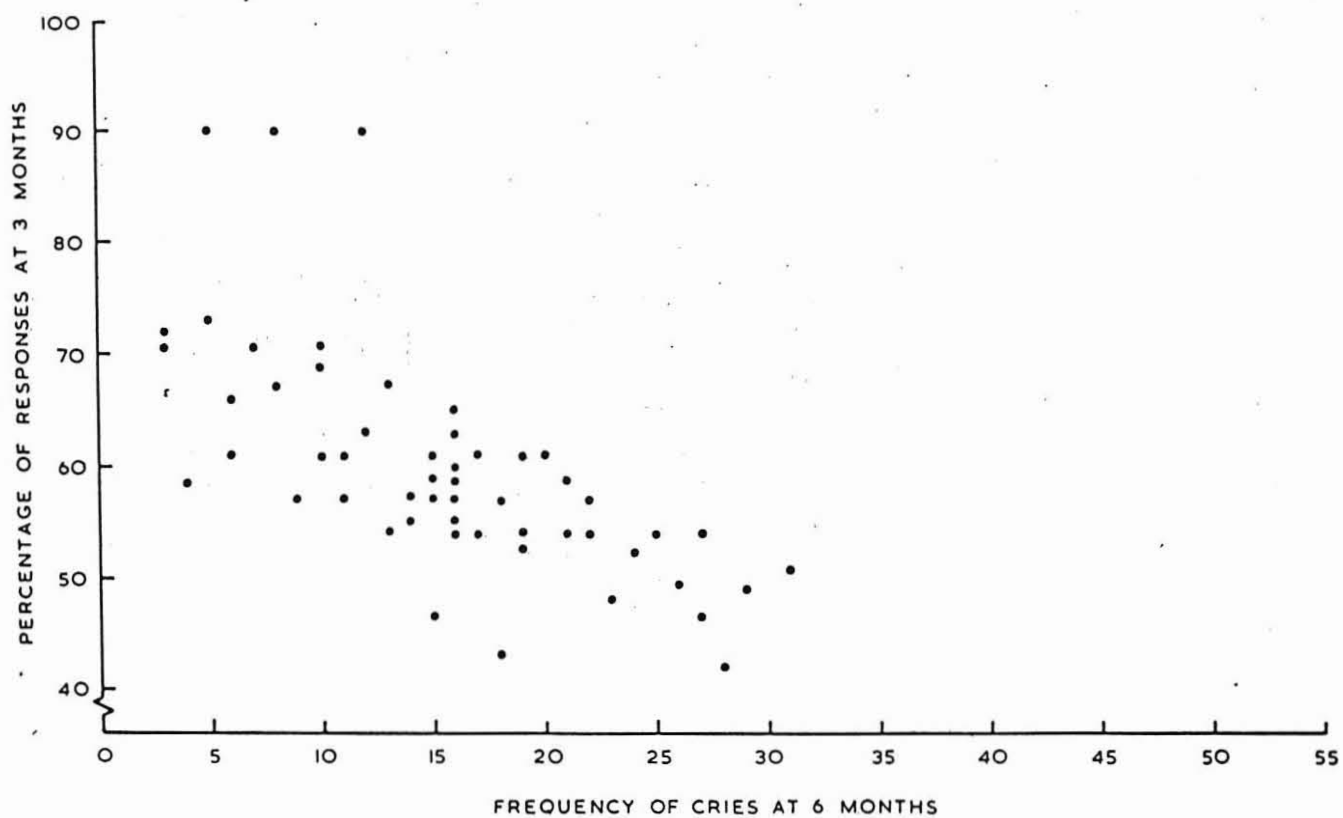


FIGURE 7.6: Scatterplot of the relationship between the proportion of cries to which mothers respond at 3 months and the frequency of cries at 6 months.

at later observations. The associations between the maternal response measures at two weeks and three months and crying at later observations are shown in Figures 7.4 to 7.6. In each case, the horizontal axes denote the frequency of infant crying and the vertical axes the percentage of cries to which mothers responded.

A summary of all these obtained correlations is given in Figure 7.7. Only those indicated by dense lines are statistically significant. An alpha level of .01 was chosen because of the large number of tests made and possible inflation of Type 1 errors.

It is clear that while infants are highly consistent across age periods (correlations between FC_1, FC_2 and FC_3), mothers are considerably less so, particularly between two weeks and three months. Examination of correlations *between* infant crying and maternal response across the age periods shows that there is little association between the mother's responsiveness at two weeks and later infant crying. Rather, it is infant crying at two weeks which is correlated with subsequent maternal responsiveness. The correlation is negative, indicating that the higher the frequency of cries at two weeks, the lower the proportion of cries to which response is made on subsequent occasions. Similarly, the frequency of infant crying at three months is also negatively correlated with the proportion of cries to which mothers respond at six months. It should be noted that the responsiveness of the mother at three months also shows a substantial negative correlation with infant crying at six months. While measures of crying and responsiveness are not significantly correlated within the two week period, they are within the three month and six month periods, but again negatively.

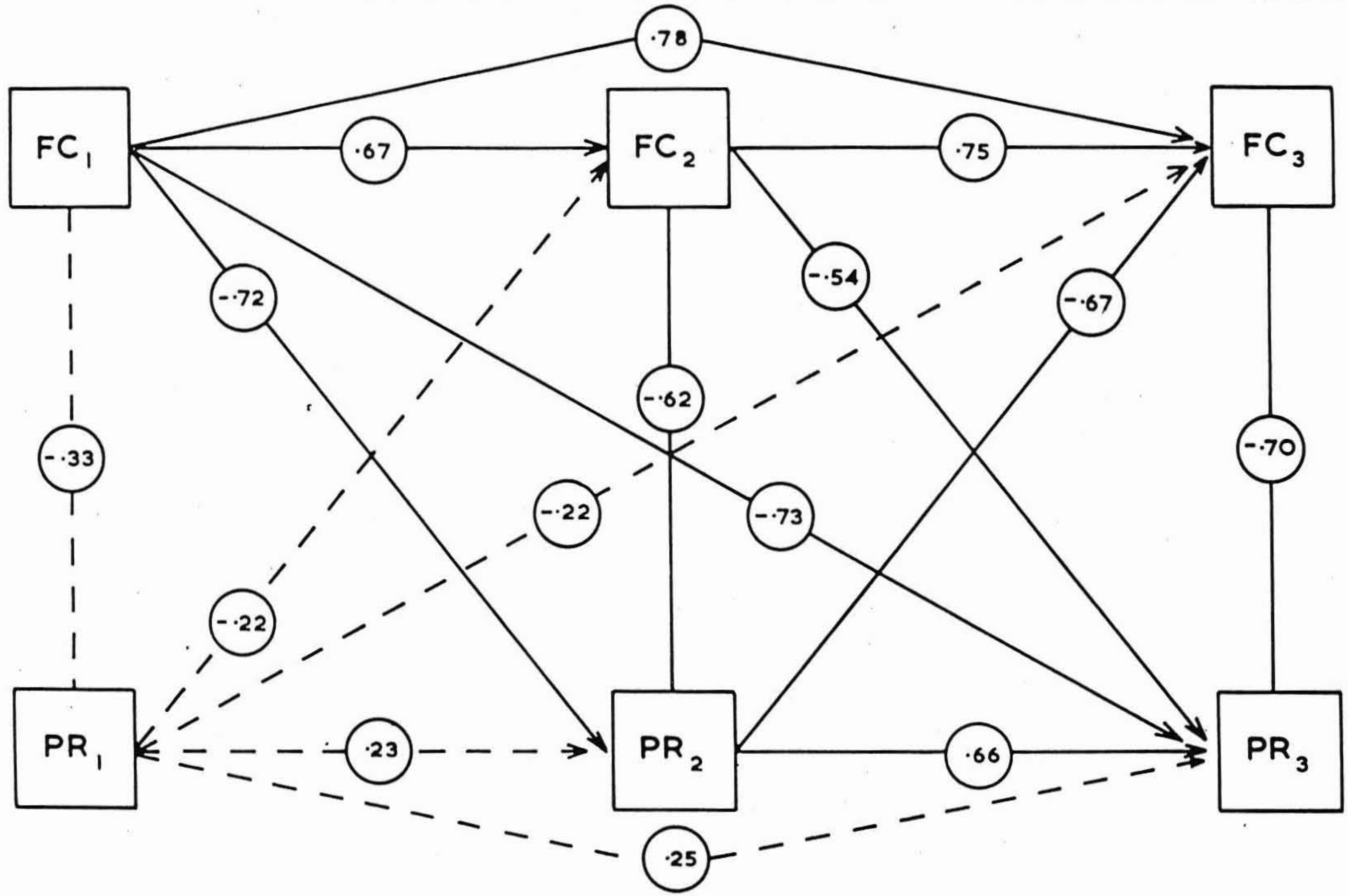


FIGURE 7.7: Correlations obtained between the frequency of cries and the proportion of cries to which mothers respond at two weeks, three months and six months.

7.3 Causal Modelling

The techniques described in Chapter 4 were used to fit the data exhaustively to all possible models. Edges were systematically removed until the most parsimonious representations of the data were obtained. These are illustrated in Figure 7.8 and the corresponding estimated covariance matrices and structural equations are given in Tables 7.1 to 7.5. Further deletions produced significant differences between estimated and obtained covariance matrices.

All the models depicted have the characteristic that the frequency of infant crying at two weeks (FC_1) is shown to determine the proportion of cries to which mothers responded on later occasions of measurement (PR_2 and PR_3). Furthermore, they all indicate consistency in crying over the three age periods. At three months the frequency of crying is related to crying at two weeks, and at six months, to crying at the two previous time periods. The model which attributes further effects of crying at three months on maternal response at six months also fits the data ($X^2 = 4.54$; df = 6), but removing this edge (FC_2 - PR_3) does not produce a significant increment in chi-square.

The most noteworthy feature of the results is that the proportion of cries to which mothers respond at two weeks and three months is unrelated to the frequency of crying on subsequent occasions. Indeed models which assume that the proportion of maternal responses to cries affects crying across age periods, and that crying has no effect on maternal response (Bell and Ainsworth, 1972) do not fit the obtained data (Figure 7.9). This is also the case for models derived from the work of Gewirtz and Boyd which predict reciprocal influences between crying and responsiveness. Although all the models in Figure 7.8 fit the data, they differ in two important respects: the postulated direction of effects within age periods and the effect of maternal responsiveness at

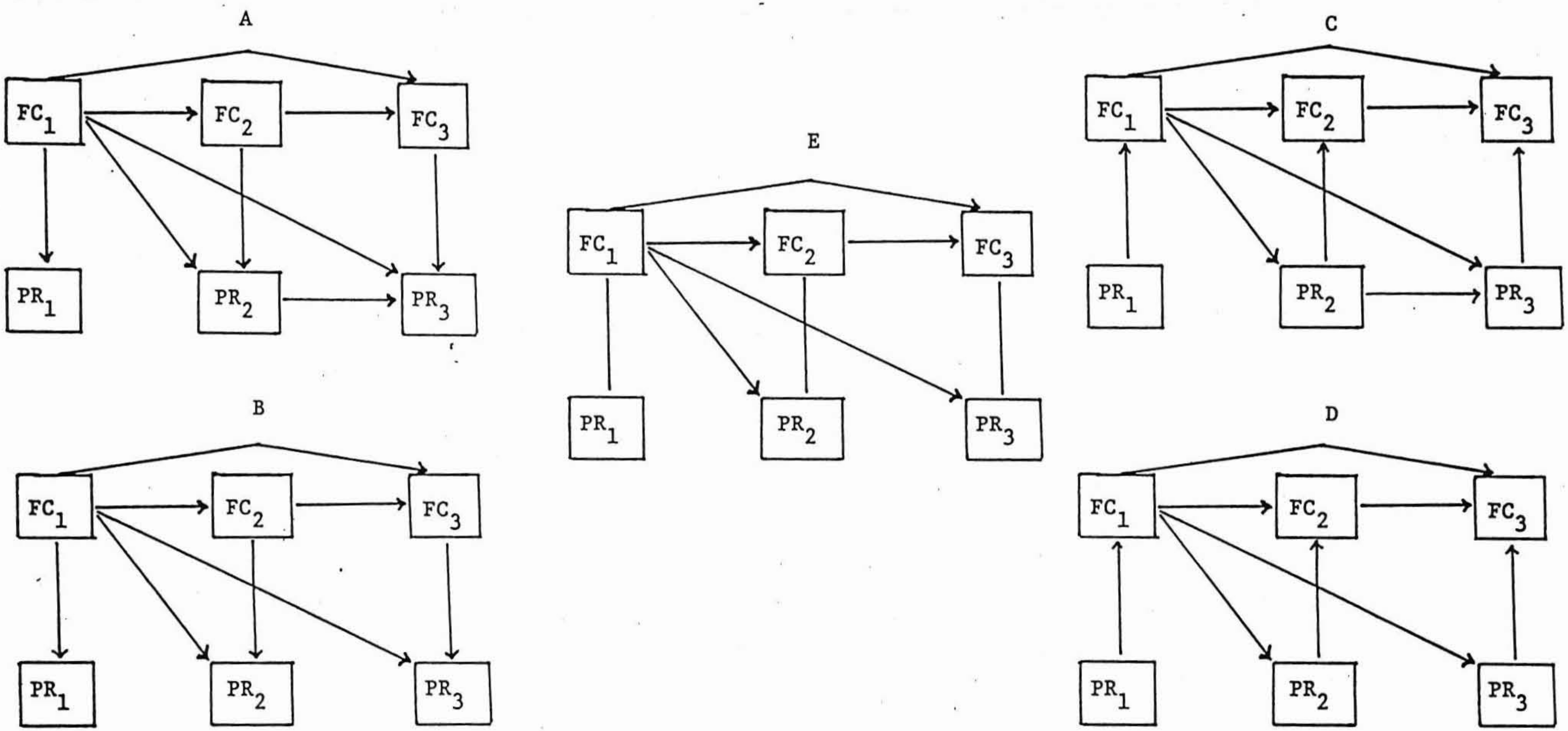


FIGURE 7.8: "Best-fit" models of the long term relationship between frequency of infant crying (FC) and proportion of cries to which mothers respond (PR).

Table 7.1: Estimated covariance matrix and equations for Model A.

	FC_1	FC_2	FC_3	PR_1	PR_2	PR_3
FC_1	1.000					
FC_2	0.670	1.000				
FC_3	0.777	0.754	1.000			
PR_1	-0.329	-0.221	-0.256	1.000		
PR_2	-0.729	-0.621	-0.623	0.240	1.000	
PR_3	-0.733	-0.584	-0.692	0.241	0.652	0.994

$$FC_2 = .670\ FC_1 + U_5$$

$$FC_3 = .423\ FC_2 + .494\ FC_1 + U_4$$

$$PR_1 = -.330\ FC_1 = U_3$$

$$PR_2 = -.246\ FC_2 - .569\ FC_1 + U_2$$

$$PR_3 = .218\ PR_2 - .279\ FC_3 - .359\ FC_1 + U_1$$

Vâr.	U_1	U_2	U_3	U_4	U_5
	.633	.661	.944	.545	.742

$x^2 = 2.0906$; df = 6.

Table 7.2: Estimated covariance matrix and equations for Model B.

	FC_1	FC_2	FC_3	PR_1	PR_2	PR_3
FC_1	1.000					
FC_2	0.670	1.000				
FC_3	0.777	0.754	1.000			
PR_1	-0.330	-0.221	-0.256	1.000		
PR_2	-0.729	-0.621	-0.623	0.240	1.000	
PR_3	-0.733	-0.369	-0.702	0.242	0.553	1.000

$$FC_2 = .670\ FC_1 + U_2$$

$$FC_3 = .423\ FC_2 + .494\ FC_1 + U_3$$

$$PR_1 = -.330\ FC_1 + U_4$$

$$PR_2 = -.240\ FC_2 - .569\ FC_1 + U_5$$

$$PR_3 = -.334\ FC_3 - .473\ FC_1 + U_6$$

Vâr.	U_2	U_3	U_4	U_5	U_6
	.551	.297	.891	.436	.419

$x^2 = 4.857$; df = 7.

Table 7.3: Estimated covariance matrix and equations for Model C.

	FC_1	FC_2	FC_3	PR_1	PR_2	PR_3
FC_1	1.000					
FC_2	0.670	1.000				
FC_3	0.777	0.751	0.998			
PR_1	-0.329	-0.221	-0.256	1.000		
PR_2	-0.729	-0.621	-0.652	0.240	1.000	
PR_3	-0,733	-0.528	-0.698	0.241	0.664	1.000

$FC_1 = -.330\ PR_1 + U_5$

$FC_2 = -.282\ PR_2 + .464\ FC_1 + U_3$

$FC_3 = -.246\ PR_3 + .402\ FC_1 + .329\ FC_1 + U_1$

$PR_2 = .729\ FC_1 + U_4$

$PR_3 = .278\ PR_2 - .53\ FC_1 + U_2$

Vâr.	U_1	U_2	U_3	U_4	U_5
	.520	.653	.717	.684	.944

$x^2 = .6015$; df = 6.

Table 7.4: Estimated covariance matrix and equations for Model D.

	FC_1	FC_2	FC_3	PR_1	PR_2	PR_3
FC_1	1.000					
FC_2	0.670	1.000				
FC_3	0.777	0.742	0.991			
PR_1	-0.329	-0.221	-0.256	1.000		
PR_2	-0.729	-0.621	-0.620	0.240	1.000	
PR_3	-0.733	-0.491	-0.683	0.241	0.534	1.000

$$FC_1 = -.330\ PR_1 + U_5$$

$$FC_2 = -\ .282\ PR_2 + .464\ FC_1 + U_3$$

$$FC_3 = -\ .246\ PR_3 + .404\ FC_1 + .330\ FC_1 + U_1$$

$$PR_2 = -\ .729\ FC_1 + U_4$$

$$PR_3 = -\ .733\ FC_1 + U_2$$

Vâr.	U_1	U_2	U_3	U_4	U_5
	.522	.680	.717	.684	.944

$x^2 = 4.993$, df = 7.

Table 7.5: Estimated covariance matrix and equations for Model E*.

	FC_1	FC_2	FC_3	PR_1	PR_2	PR_3
FC_1	1.000					
FC_2	0.670	1.000				
FC_3	0.777	0.742	0.991			
PR_1	-0.330	-0.221	-0.256	1.000		
PR_2	-0.729	-0.621	-0.620	0.240	1.000	
PR_3	-0.733	-0.491	-0.683	0.242	0.535	1.000

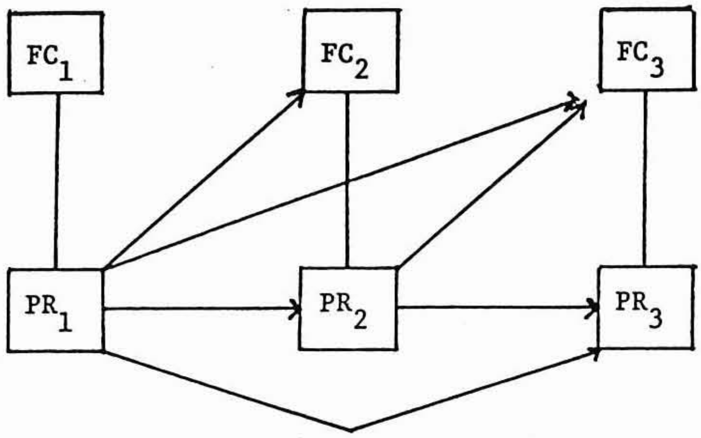
$$\begin{array}{cccccc} FC_3 & PR_3 & FC_2 & PR_2 & FC_1 & PR_3 \end{array}$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & -.733 \\ 0 & 1 & 0 & .402 & 0 & .508 \\ 0 & 0 & 1 & 0 & 0 & -.729 \\ 0 & 0 & 0 & 1 & 0 & .670 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} PR_3 \\ FC_3 \\ PR_2 \\ FC_2 \\ PR_1 \\ FC_1 \end{bmatrix} = \begin{bmatrix} U_6 \\ U_5 \\ U_4 \\ U_3 \\ U_2 \\ U_1 \end{bmatrix}$$

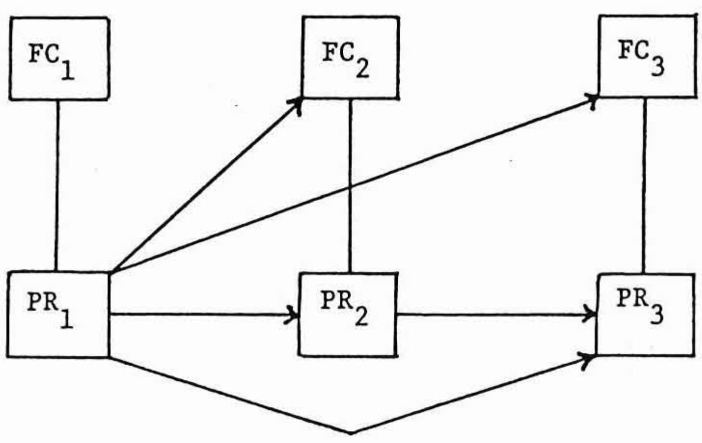
Var.	U_1	U_2	U_3	U_4	U_5	U_6
	1.00	1.00	.551	.486	.297	.463

$x^2 = 4.9934$; df = 7.

* This model is parameterized by a Choleski factor (Kiiveri and Speed, 1981).



$\chi^2 = 86.859$
df = 6



$\chi^2 = 92.433$
df = 7

FIGURE 7.9: Models derived from the Bell & Ainsworth (1972) position on the direction of effects between infant crying and maternal responsiveness.

three months on the same variable at six months. Models A and B both show the direction of effects within age periods as being from FC → PR, while C and D specify the opposite direction of influence (PR → FC). Model E, a simultaneity model, involves no assumptions about the direction of effects within periods. Choosing among these alternatives is largely a matter of interpretation, since all provide an adequate description of the data. Assuming that models A and B apply and remembering that the correlations between FC and PR within observations are negative, the conclusion would be that the more the infant cries, the less likely the mother is to respond. Equally it is possible that the fewer the cries to which a mother responds, the more likely the infant is to cry (Models C and D). Since data on these variables were collected simultaneously, it is not possible to choose between these alternatives on empirical grounds. It, therefore, seems more reasonable to argue that both processes may be operating and to select model E as the most parsimonious representation of observed effects within age periods.

A further difference between the models illustrated lies in the link between the proportion of cries to which mothers respond at three months and at six months ($PR_2 \rightarrow PR_3$). Models A and C which include this edge imply that the mother's responses at three months, in part determine her responses at six months. However, deleting this edge does not produce significant increments in Chi square nor disturb the overall goodness of fit. In particular, eliminating $PR_2 \rightarrow PR_3$ from Model A to give model B produces an increment in Chi square of 4.392, a difference which fails to achieve significance at the 0.01 level (df = 1). Similarly, changing model C to model D by eliminating the same edge increases Chi square by 2.7664 which, again, is not a significant difference (df = 1; $p > .01$). Differences in Chi square between models A and E (4.3919) and models C and E (2.9028) are also not significant (df = 1; $p > .01$).

In summary, the most parsimonious model is E, which assumes consistency in infant crying across age periods and indicates that infant crying is not the result of maternal responses to cries on earlier occasions. Furthermore, it attributes changes in maternal responses to crying at three months and six months to the frequency of infant crying at two weeks. In other words, it is the initial level of infant crying which determines subsequent maternal responses to cries and not the reverse direction of effects. No assumption is made about the direction of influence within age periods.

7.4 Limitations of Causal Modelling Technique

Before discussing the findings derived from the causal modelling procedures, several cautionary comments are in order. As Kenny has pointed out "one cannot take bad data and turn (them) into gold by calling (them) a causal model (1979, p. 8). Attempting to answer causal questions from a set of non-experimental data is requiring a great deal of those data. It is particularly important to determine whether the assumptions of the methods used are satisfied before having any confidence in the results.

One major difficulty in constructing such models is the possibility of *specification errors*. The process of selecting variables to be used in the model and specifying the relationships among the variables is the specification of the model. Errors in specification may take the form of omitting significant causal variables or wrongly assuming that a given causal path is not important. As Duncan (1975) has suggested, specification error "is quite a useful euphamism for what in blunter language would be called 'using the wrong model'" (p. 101). In the present investigation, models tested were derived from available theory and research, but while the results obtained show clearly which models do *not* obtain, they may not represent all the causal variables which are, in fact, operating.

The second problem is that of *identification*. A model is said to be identified when all the causal parameters can be estimated from the data as they were in this study. Under-identification exists when there is insufficient information to estimate all of the causal parameters.

Finally, it is important to consider two factors which may make covariance a misleading measure of association: *outliers and non-linearity*. Scores that are very deviant from the mean may distort covariances.

These outliers may be the result of (a) measurement errors, (b) multiple populations, or (c) random values. Examination of scatterplots, particularly those in Figures 8.1 to 8.5 show that there were indeed one or two outliers. These are unlikely to be due to measurement error because of the recording technique employed and the considerable efforts which were made to ensure reliability. There is also not a sufficiently large number of outliers to suggest that we were dealing with a bimodal population. As Kenny (1979) suggested those interested in unraveling causal relationships are well advised to exclude deviant groups from their studies. This was specifically built into the procedure for selecting subjects. Mothers and infants considered to be 'at risk' for atypical or disturbed behaviour were excluded (Chapter 4). Some outliers are to be expected by chance, and it is probable that this was the reason for the occasional exceptional cases observed in this study.

Finally, using covariance as a measure of association presumes that the functional relationship between variables is linear. The simplest test of linearity is to examine the scatterplots between the relevant variables. Examination of Figures 8.1 to 8.5 indicates that relationships obtained were sufficiently linear to justify the use of the modelling techniques.

7.5 Individual Data: The Gewirtz and Boyd Model

The fitted models for group data presented in the previous section do not support the Gewirtz-Boyd prediction of reciprocal influences between infant crying and maternal response to crying over time. However, as indicated in earlier discussion, Gewirtz (1977) and Gewirtz and Boyd (1977) have argued that an adequate test of an operant interpretation of the modification of crying depends on analysis of individual data.

The first of the research questions derived from the Gewirtz-Boyd argument is the issue of the relationship between the reinforcement schedules applied to each category of fuss-cry event and subsequent changes in the proportion of cries in each category. Ideally, one would wish to compare infants for whom virtually all cries in a given class were ignored (extinction), with those who experienced intermediate (partial) and total (continuous) proportions of maternal response. While the last two cases are adequately represented among the subjects sampled, there was no infant who experienced the very low levels of response characteristics of an extinction schedule. For this reason, it was only possible to compare infants who obtained intermediate and high proportions of maternal response for each class of cries.

Since infants only infrequently emitted cries separately from fusses, isolated cries were combined with more extended sequences beginning with a cry, leaving three classes of event for analysis: fusses alone, sequences beginning with a fuss, and sequences beginning with a cry. For each class of event, subjects were selected who had similar proportions of cries in that class and comparable total rates of crying at two weeks of age. A further criterion for selection was that their mothers showed similar overall levels of responsiveness, but clearly differed in the proportion of responses made to cries within the selected class. Data from four subjects were analyzed for each class of fuss-cry event. For each subject, changes between two weeks and three months in the proportion of cries within the selected class were determined.

Table 7.6 shows the results obtained. This indicates that there is no apparent relationship between the reinforcement schedules applied (% cries to which mother responds) and subsequent changes in the proportion of cries in a given class of fuss-cry event. For example, for fusses alone, there is no difference at three months between subject 1 who obtained virtually continuous

Table 7.6: Individual data relating rates of maternal response to fuss-cry events to changes in per cent of total cry sequences represented by each event.

a) Fusses alone	Subject Number			
	1	2	3	4
Number cry sequences	29	31	27	36
% fusses (two weeks)	41.4	45.2	40.7	44.1
% response to fusses (two weeks)	91.7	85.7	63.6	46.7
% fusses (three months)	46.2	39.7	42.1	40.7

b) Sequences beginning fuss	Subject Number			
	5	6	7	8
Number cry sequences	25	24	23	23
% fuss sequences (two weeks)	47.1	43.9	49.1	46.7
% response to fuss sequences (two weeks)	93.4	81.2	60.7	43.1
% fuss sequences (three months)	41.3	37.6	48.2	39.1

c) Sequences beginning cry	Subject Number			
	9	10	11	12
Number cry sequences (two weeks)	27	29	24	29
% sequences beginning cry (two weeks)	18.5	20.7	20.8	17.2
% response to sequences beginning cry (two weeks)	80.0	83.3	100.0	100.0
% sequences beginning cry (three months)	15.3	12.9	12.1	14.6

reinforcement (92%) at two weeks and subject 4 whose mother responded to only 47% of fusses. Similarly, for sequences beginning with a fuss, infant 8 who obtained a response on only 43% of occasions at two weeks does not appear to differ at three months from infant 5 who was ignored on only 7% of occasions. The narrow range of maternal response for sequences beginning with a cry precludes sensible analysis in operant terms, although there is again no systematic difference between the infants at three months which can be related to differing reinforcement schedules at two weeks.

The second question requiring analysis of individual data is that of the effects on crying rates of differential reinforcement of responses other than crying (DRO). This question can be addressed by comparing the frequencies of crying at three months for infants whose mothers ignored a substantial proportion of cries at two weeks but differed in terms of the probability of a response following the termination of crying. Four subjects with comparable frequencies of cry sequences and levels of maternal response less than 60% were selected. Two of these infants had mothers who showed an accelerated rate of responding conditional on the termination of crying. This was determined using a lag sequential analysis with a trailing edge and the termination of crying as the trigger for the analysis. Ten one second lags were examined. For the other two infants, the probability of response following the termination of crying was no different from the unconditional probability of response at any one second instance in the behavioural record.

Results for these mother-infant pairs are presented in Table 7.7. Again, there are no apparent differences among the infants in the frequency of cry sequences at three months which can be attributed to the application of a DRO schedule.

The remaining question relating to an operant interpretation of the modification of crying is whether

Table 7.7: Individual data on the relationship between accelerated responding on cry termination at two weeks and number of cry sequences at three months.

	Response on cry termination accelerated		Response on cry termination not accelerated	
	Subject			
	1	2	3	4
No. cry sequences (two weeks)	28	31	34	29
% cries ignored (two weeks)	60.7	54.8	55.9	58.6
No. cry sequences (three months)	31	27	26	34

the contingencies operating between maternal response and the events which precede or accompany crying produce changes in the circumstances in which the infant will later cry. Group data indicate that there is a clear relationship between the events which precede cries and the likelihood of maternal response.

Whether the infant learns this association and later inhibits crying in circumstances previously associated with a low probability of maternal response can be determined by examining changes in the events which precede cries (determined by lag sequential analysis) subsequent to the adoption of such strategies by the mother. Three infants who had comparable levels of crying at two weeks and who obtained a similar overall level of responses from their mothers were selected for analysis. A further requirement was that they cried upon being put down by the mother and that the mothers differed in the probability that they responded to cries precipitated in this way. This particular event was selected because it was one of the few which reliably preceded crying at two weeks and continued to do so until six months.

The results, showing changes up to six months, are given in Table 7.8. In behavioural terms, infant A experienced a virtually continuous reinforcement schedule for cries precipitated by being put down, infant B a partial reinforcement schedule and infant C an extinction schedule. The results suggest that the extinction strategy was successful in later preventing crying in this situation, but although the overall level of crying diminished, it did not appear to differ from that of the other two infants.

7.6 Limitations of Lag Sequential Analysis

Caution also needs to be exercised in interpreting data derived from the lag sequential analysis technique (Sackett, 1978, 1979; Chapters 5, 6 and 7). Although it is a definite improvement over simple counts of frequency and duration, it is still not ideal. Three problems require consideration: (i) the inability of the technique to deal with low frequency events; (ii) the tendency to capitalize on chance; and (iii) the over-simplified hypothesis testing techniques.

Where behaviours of interest have a low frequency of occurrence, they cannot be tested for significance using Chi square or Z techniques, since the expected frequencies must be greater than 5. Although increasing the observation time can improve the chances of sampling low probability events, this may be prohibitive in practice. This was a problem in the present study since isolated cries occurred so infrequently that the technique could not be used for this class of event.

In testing for significant results from the large volume of data generated by naturalistic observation, the more tests that are made, the more likely it is that some

TABLE 7.8: Individual data on relationship between % response to cries preceded by event 'puts down' and frequency of cries to that event at later age periods.

Subject number	Number of cry sequences	% response	Number of cry sequences to 'puts down'	% response to cries to event 'puts down'	
A	27	70.4%	7	100%	2 weeks
B	26	76.9%	9	55%	
C	26	72%	6	6%	
A	24	62.5%	8	87.5%	
B	29	69.0%	11	45%	3 months
C	22	72.7%	3	0%	
A	17	64.7%	5	80%	
B	19	63.1%	4	75%	6 months
C	16	68.7%	0	-	

will be 'significant' that is, the Type 1 error is likely to be high. As Sackett (1979) has suggested, the extent of this problem can be reduced by checking results to ensure that they make psychological sense and that more than alpha (Type 1 error rate) of probabilities derived are significant, as they were in this study.

A more worrying problem is the questionable validity of the assumption underlying the null hypothesis: that the sequential flow of behaviour is random. It is clear, particularly when dealing with behaviour emitted by a single individual, that behaviours which occur close together in time will be more similar than those occurring far apart. This means that the simple null hypothesis will frequently be rejected. Lag analysis will always produce some significant results, as will any of the concurrent or pattern sequential methods (Bakeman, 1978). What seems to be required is a *model* testing approach similar to that described by Thomas and Martin (1976). Data might then be tested for goodness of fit to theoretically generated lag profiles.

Despite these qualifications, it is now possible, with sampling techniques and coding strategies similar to those used in this study, to generate data which are reasonably representative of the flow of events in mother-infant interaction and to analyze them for consistent, recurrent patterns of the type surrounding the occurrence of infant crying.

7.7 Long Term Changes in Social Behaviour During Interaction

Within age periods there were no clear relationships between the frequency of crying and social behaviour until six months (Chapter 5). At this time the frequency of crying was shown to be positively correlated with both the percentage of corrected interaction time during which the infant smiled, vocalised and looked at the mother and the likelihood of these behaviours being contingent upon maternal behaviour. There was, in addition, some stability in these behaviours as is illustrated in Tables 7.9 and 7.10. There were significant correlations between the interaction time measures at two weeks and six months and between three months and six months. This pattern of association also held for the contingency of social behaviour on maternal behaviour.

Table 7.9: Correlation between percentage of interaction time infants spend in social behaviour across age periods.

Age	2 weeks	3 months
3 months	0.23	
6 months	0.38*	0.57**

Table 7.10: Correlations across age periods in the probability of looking, smiling and vocalising following maternal behaviour.

Age	2 weeks	3 months
3 months	0.19	
6 months	0.36*	0.41**

In addition there were significant relationships between the frequency of cry sequences and these measures of social behaviour across age periods (Tables 7.11 and 7.12). The frequency of infant crying at two weeks and at three months was positively associated with the percentage of interaction time taken up with smiling, vocalizing and looking at the mother at six months.

Table 7.11: Correlations between frequency of cry sequences and % interaction time spent in social behaviour within and between age periods.

		Frequency cry sequences		
		2 weeks	3 months	6 months
% interaction time in social behaviour (Arcsin transformed)	2 weeks	0.11	0.19	0.26
	3 months	0.16	0.17	0.22
	6 months	0.32	0.45**	0.39**

Table 7.12: Correlations between frequency of cry sequences and probability of smiling, looking and vocalising following maternal response.

		Frequency cry sequences		
		2 weeks	3 months	6 months
p. social behaviour following maternal behaviour (Arcsin transformed)	2 weeks	-.04	-.07	.15
	3 months	.16	.09	.22
	6 months	.12	.37*	.34*

Crying at three months, but not earlier, was also associated with the probability of social behaviour being contingent on maternal behaviour at six months.

As already indicated, maternal responses to crying and other aspects of maternal responsiveness were not associated within time periods. Nor was there any consistent pattern of association between these variables across time periods.

B. DISCUSSION

7.9 Long-term Changes and the Direction of Effects: Group Data

The major concern of the present investigation has been to determine the long-term effects of maternal responsiveness to cries on the amount of infant crying and conversely, to assess the contribution of the amount of infant crying to changes in maternal responsiveness. Both group and selected individual data were analysed in order to examine this issue.

The consensus in the research literature and in child care manuals has been that the amount of crying is relatively easily modified by the frequency and promptness of maternal responses to cries. In much of this literature, however, there has been only fleeting acknowledgement of individual differences in crying among infants and of the possible effects of these differences on maternal behaviour. Long-term changes in crying are clearly believed to be the result of patterns of maternal response to cries, although the precise effects of these responses have been in dispute.

One school of thought, now relatively unpopular, is that responding promptly and often to cries will increase the amount of crying. Mothers have been warned that picking up the crying baby between feeds would encourage the bay to use crying to get attention and produce a "spoiled, fussy baby" (U.S. Children's Bureau, 1924). This view is a popular form of that espoused by behaviourists such as Gewirtz (1977) who has argued that responding to 'operant' cries will increase the amount of crying and, conversely, that ignoring such cries and reinforcing competing responses such as smiling will diminish the amount of crying.

Parents are now encouraged to be permissive in responding to cries since "it is the baby who is left ... awake and crying ... for an hour at a time who tends to become demanding and difficult" (p. 210). A similar view was expressed by Arnstein (1981) who cited Bell and Ainsworth's (1972) findings as justification for her position.

Indeed, it may be argued that the work of the attachment theorists, and of Bowlby and Ainsworth in particular, has influenced views about the management of crying prevalent today. They have argued that the mother who responds reliably and promptly to cries will develop the infant's "confidence in his own ability to control what happens to him" (Bell and Ainsworth, 1972), and will foster the infant's use of methods of communication while demanding the infant's readiness to use crying as a means of gaining maternal attention.

Group results from the present study do not support either of these views. Individual differences in the frequency and average duration of cry sequences were substantial and there was also considerable individual consistency in both indices across time periods. The fitted models showed that this consistency was not an indirect result of maternal behaviour which was, in any case, relatively inconsistent except between three and six months. The frequency of infant crying over time could be predicted without reference to the proportion of cries to which mothers made response. Indeed models which assumed that infant crying at three and six months depended on earlier maternal responsiveness did not even approximate the obtained data. Similarly, intermediate models allowing reciprocal influences between crying and responsiveness across periods did not adequately represent the findings.

The correlations obtained and the fitted models showed, on the contrary, that it was the mothers' behaviour and not the infants' which was changed over the six month period the study was conducted. The "best-fit" models showed that the proportion of cries to which mothers responded at three and six months clearly depended on the frequency of cry sequences at two weeks. In addition, it was not necessary to invoke infant crying at three months in order to account for maternal responsiveness at six months. In other words, it was the initial level of crying which determined later maternal responsiveness. The negative correlations obtained indicated that the greater the number of cry sequences at three weeks, the less likely was the mother to respond on later occasions. In other words, the most parsimonious model most closely resembled that derived from the work of Moss (1967) and Dunn (1975).

Before elaborating further on the implications of these findings it is necessary to examine the Gewirtz-Boyd position more closely and to comment further on discrepancies with the Bell-Ainsworth findings.

7.10 Individual Data: The Gewirtz-Boyd Model

Gewirtz has argued that in order to ascertain the adequacy of an operant interpretation it is necessary to specify the contingencies operating between infant crying and maternal response. According to Gewirtz this requires identification of classes of cries upon which maternal responses are contingent, specification of reinforcement schedules, and description of discriminative cues for infant crying. He has further argued that group results mask these processes and that it is necessary to describe the unique conditioning history of each mother-infant pair to make sense of long-term changes.

In his 1977 analysis of cued crying, Gewirtz specifically assumed that a particular class of cries (defined by latency, duration, intensity or topography) might constitute a functional unit with respect to maternal response. Furthermore, he argued that a "reinforcing agent" (sic) might respond consistently and contingently to that class and that parents' responses, according to some schedule, would provide reinforcing stimuli for the crying responses. Indeed, this seems to be the case. Groups data showed overall that mothers were less likely to respond and less prompt in responding to fusses alone and sequences beginning with a fuss than they were to cries. There were also considerable differences among mothers in the reinforcement schedules (% response) applied to each class of cry.

Gewirtz further assumed that the reinforcement schedules applied to these classes of crying response would produce changes in the patterns of infant crying. He suggested, for example, that one mother might shape up high intensity cries by consistently responding to this class of events and ignoring low intensity precursors of crying. In addition, he argued that intermittent schedules of reinforcement should produce higher and more stable rates of crying in a given class and that extinction and differential reinforcement of other (than crying) responses should reduce the amount of crying.

The data from selected mother-infant pairs do not seem consistent with this analysis. There were no apparent relationships between the reinforcement schedules applied to the various classes of fuss-cry events at two weeks and the proportion of cries in each category of event on the next occasion of measurement. Nor were there any changes in the amount of crying subsequent to the adoption of DRO schedules (indicated by accelerated responding at the termination of crying).

It should be made clear, however, that extinction schedules (zero or near zero response rates) to classes of fuss-cry event defined by intensity and topography were never employed by the mothers in this study. Hence it was only possible to compare partial with continuous reinforcement schedules. However, Gewirtz' own analysis of cued crying would have predicted higher rates of crying in those cases where partial rather than continuous reinforcement schedules were applied. This was not the case.

There was only one clear identifiable instance of an extinction schedule being applied. One mother systematically ignored cries precipitated by her moving out of contact with the infant. She eventually succeeded in eliminating cries in this context, but there was no apparent difference between the amount of crying exhibited by her infant and that of infants whose mothers continuously or partially reinforced such cries.

Together these results suggest that while it may be possible to modify the circumstances in which crying occurs, the reinforcement schedules applied to classes of cry defined by the attributes of intensity and topography do not produce changes in the proportion of cries in a given class. The major difficulty in testing Gewirtz' arguments about the modification of crying is that the concepts, particularly those relating to the definition of response classes, are not clearly defined (Chapter 3). In addition, while much of his discussion refers to 'operant' crying, he has never provided a clear definition of what is intended by the term, although the implication of his analysis is that operant cries are those which are elicited by absence of departure of the caretaker. However, in his analysis he has concentrated on attributes of the cry rather than the circumstances which elicit crying as essential to an operant interpretation. He has specifically stated that his conception of reinforcement is that there are events, which, when contingent on behaviour, will change the rates of those behaviours. The one significant finding from these individual data suggests rather that the infant learns the association between contingent maternal response and the stimuli which precede or accompany crying. This is closer to Estes' (1972) hypothesis that reinforcing stimulation provides opportunities for the organism "to learn a relationship between the stimulus which elicited its response and the reinforcing stimulation" (p. 726).

Perhaps the most significant finding, however, is that mothers almost never employed extinction schedules to classes of cries, whether those cries were defined by cry attributes or by the circumstances which elicited them. While an operant learning model may be appropriate to understanding how crying behaviour *can* be modified in artifically constructed laboratory demonstrations it contributes little to understanding how such change is actually produced in the home environment. As already indicated, group results suggest that the amount of crying is not affected by maternal behaviour. Rather, the reverse is true.

7.11 Discrepancies with the Bell-Ainsworth Findings

The discrepancies between the present findings and those of Bell and Ainsworth (1972) on the direction of effects between infant crying and maternal responsiveness require further comment. Significant problems in the measurement of variables and in the analysis and interpretation of results in the Bell-Ainsworth study have already been described. In addition to those methodological problems, several other differences may be important. In discussing their findings, Bell and Ainsworth gave the impression that data were collected when the infants were 3, 6, 9 and 12 months of age. In fact, data were collected for the majority of subjects from the time the infants were three weeks old, and thereafter, at three weekly intervals. Each time period measure is, thus, an amalgum of data collected over the preceding quarter, a procedure which may have masked some of the more subtle changes taking place.

In addition, examination of their reported correlations shows two significant correlations between infant crying and subsequent maternal ignoring of cries and two between the number of crying episodes ignored and subsequent crying, yet they interpret this to mean that it is maternal responsiveness which influences infant crying and not the reverse. Similar problems exist with their interpretation of correlations between duration of crying and duration of maternal unresponsiveness. Furthermore, the lack of statistical control over earlier quarter crying and/or unresponsiveness means that significant correlations were accepted at face value. Simply examining the correlations obtained in the present investigation, particularly those between three and six months, would give the impression that maternal responsiveness at three months affected subsequent infant crying. The procedure of structural equation modelling revealed this to be an indirect effect accounted for by the earlier impact of infant crying on maternal responsiveness (P FC_1/PR_2) and the strong association between infant crying over all three time periods.

Finally, the fact that some mothers in the Bell-Ainsworth study apparently ignored virtually *all* their infants' cries may be important. It is possible that extreme levels of unresponsiveness do have a more potent influence on later infant crying than is suggested by the results of this study. Due to accidents of sampling or history, such extreme levels were not tapped in this investigation. The most unresponsive mother still responded to half her infant's cries.

7.12 The Significance of the Findings

The results obtained clearly support the model suggested by the work of Moss (1967) and Dunn (1975). The frequency of cry sequences shown by infants was a highly consistent attribute relatively unaffected by the level of maternal responsiveness to cries. Measures of duration of crying showed the same pattern but could not be sensibly used in causal modelling since the duration of fusses and cries clearly depends on how quickly the mother responds. Any stability in the duration of crying might thus be attributed to stability in the mother's behaviour in response to cries although, in this study, duration to respond was not found to be consistent over the first three months.

Mothers clearly changed their behaviour in response to the level of crying characteristic of their infants. The group of mothers studied were initially very homogeneous in their behaviour, in that they responded promptly to a high proportion of their infants' cries. At two weeks there was no significant relationship between the frequency of cries and the proportion of cries to which mothers responded. By six months, the distributions for both percentage response and duration to respond were more dispersed. Furthermore, the level of responding shown by each mother could be predicted from the frequency of cries shown by their infants at two weeks. The more infants cried at that time, the less likely were mothers to respond on subsequent occasions. It thus appears that the mother's responsiveness to cries is shaped by the infant's level of crying and not vice versa.

Similar conclusions were reached by both Moss (1967) and Dunn (1975) although neither used sufficiently rigorous methods of data collection and analysis to justify their conclusions. In addition both measured the relationship between total crying and the amount of contact which mothers had with their infants, and not their responses to cries. Moss (1967) for example correlated measures of maternal contact (holds plus attends) with measures of infant irritability (combined fussing and crying) *within* observations conducted when infants were three weeks and three months old. Overall he found significant positive correlations between these measures, although at three months there were negative correlations for the more irritable males. He concluded that the more infants cry the more contact they would have with their mothers and argued that the correlations he obtained reflected a causal sequence in which the cry instigated maternal interventions. He further argued that the amount of crying shaped the mother's behaviour and not the reverse. His explanation of the negative correlation obtained for three month old males was that mothers of the more irritable boys may have learned that they could not be successful in quieting them and as a result became less willing to intervene. Other explanations of Moss' (1967) findings are possible. For example, the negative correlations for males could be interpreted to mean that the higher rate of crying was the result not the cause of lowered maternal contacts, the view favoured by Bell and Ainsworth (1972). No conclusions can be drawn from correlations of this kind, especially when they are only computed *within* a single time period.

Dunn's (1975) results are similarly difficult to interpret. She presented a complex series of correlations between frequency and duration measures of crying and measures of maternal contact and maternal delay in responding. She did find, however, that there was little consistency in mothers' latency to respond to cries and that long crying times and a high frequency of crying bouts at 14 weeks were associated with decreased maternal contact at 20 weeks. In other words, the more the baby cried at 14 weeks, the less contact the mother had later on. She acknowledged that total crying depends in part on the rapidity of the mother's response to crying. Those who delayed longest and ignored most cries might not only have less contact with their infants but could also inflate their infant's crying scores. However, she failed to find any significant correlations between measures of maternal contact and crying measures within any observation period. Although she has apparently not reported the specific correlations between crying and percentage response to cries, Dunn claimed during a discussion of her 1975 paper that "the amount of crying the baby had done at 8 weeks had a negative relationship with the mother's response to his crying at 14 weeks" (p. 172). She claimed that no correlations were in the direction which indicated that the more responsive the mother, the less crying was exhibited by the baby at the next stage.

Despite the weaknesses of Dunn's data they do offer some support for those obtained in the present study. In summary, these show that mothers whose babies were very irritable became less responsive to cries but this had little or no feedback effect on the amount of crying, at least within the first six months. A possible explanation of this finding is Moss' argument that babies who cry a lot are also difficult to soothe and that mothers are therefore negatively reinforced for responding. Mothers learn that they cannot be successful in quieting the crying and become less interested in attempting such intervention. Despite the fact that the length of time from maternal intervention to cessation of crying is also an index of maternal effectiveness, it is possible to examine the relationship between the frequency with which infants cry and the length of time it takes them to quiet. These results were presented in Chapter 6. They showed clearly that at all three periods those infants who cried most frequently also had longer cry durations subsequent to maternal response, that is, they took longer to soothe. This correlation may have been mediated by maternal behaviour. When mothers ignore a high proportion of cries and delay in responding to cries it is possible that infants take longer to soothe than they do when response is prompt. However, at two weeks there was no association between maternal delay in responding and the duration of crying subsequent to maternal response. Neither was there any substantial association between the frequency of crying and maternal responsiveness. This suggests that the longer soothing time required by infants who cried frequently was not, at this age, a function of maternal behaviour. Those infants who were initially likely to cry very often were also more inconsolable than infants who cried only infrequently; that is, they were less responsive to maternal intervention designed to terminate cries. Later there were correlations between maternal delay in responding and the length of time babies cried after maternal intervention, although this may have been due to the fact that at three and six months those mothers who delayed longest were also those whose infants cried most frequently.

Another possible explanation of these findings is that high rates of crying elicit "egoistic" motivation in the mother (Hoffman, 1975). Hoffman has argued that continued exposure to cry sounds and the resulting experience of high levels of emotional arousal might shift the mother's motivation in responding to cries from altruistic to egoistic. Rather than being concerned to alleviate the infant's distress, the mother attempts to alleviate her own distress at having to listen to crying for long periods of time. Tompkins (1963) has also argued that distress cues from another should be sufficient to activate distress in the listener but not so disturbing as to elicit avoidance of, or aggression toward, the victim. The high rates of crying typical of some infants may have exceeded the mothers' tolerance limits and resulted in them ignoring more cries than mothers whose limits were not exceeded. Murray (1979) has further argued that frequent exposure to excessive crying could be expected to "result in anger toward and avoidance of the source of the sound" (the infant) (p. 207).

In the present study there was no evidence of such generalized avoidance although mothers of babies who cried frequently became less "permissive" in their attitudes toward the management of crying. Although mothers of babies who cried frequently ignored more cries and delayed longer in responding, there was no association between the tendency to ignore cries and the quantity and quality of interaction with infants. Dunn (1975) also failed to find any clear association between response to cry measures and measures of affectionate talking, smiling and touching. It seems that those mothers whose babies are very irritable do not apparently show a generalized avoidance toward their infants.

Indeed if the time taken up with feeding and crying is included in the interaction time measure, there are positive correlations at all three ages between the frequency of crying and the amount of maternal contact with the infant. This is identical with the Moss(1967) finding of a positive correlation between infant irritability and maternal contact at three weeks and three months.

This finding may account for the greater amount of social behaviour seen in infants who cried frequently. By six months those infants who had high crying rates also showed the most smiling, vocalizing and looking at the mother and were more likely to exhibit these behaviours in response to the mother's behaviour. Furthermore, the amount of crying at two weeks predicted the amount of social behaviour at later observations.

A similar correlation between early irritability and later social behaviour was observed by Fish and Crockenberg (1981(a)). They also reported (Crockenberg and Fish (1980) that babies who took a long time to soothe during the first three months had mothers who spent more time engaging them in interaction over that period. It is likely that the irritable infant who is relatively difficult to soothe induces the mother to spend more time in interaction despite her tendency to ignore a relatively high proportion of cries. This greater involvement may stimulate the infant's subsequent sociability.

It is also possible that the amount of crying is an indirect manifestation of sociability. Those infants who cry most may be those who are more sensitive to the departure of the mother and to reduced levels of social stimulation. Examination of the correlations between frequency of crying and the proportion of cries (Arcsin transformed) preceded by loss of physical contact with or departure of the mother confirm this suggestion. Those infants who cried most also had a greater proportion of cries precipitated in this way ($r = .49$, $p < .01$), although it should be remembered that they actually spent more time in contact with their mothers. This characteristic may be later evident in their greater sociability and responsiveness during interaction.

Kagan (1971) reached a similar conclusion on the basis of his finding that female infants who had become so irritable during laboratory testing at four months that testing was discontinued were the most talkative at 27 months.

The possibility that heightened irritability in the newborn is a precursor of later intellectual ability deserves consideration. Karelitz, Fisichelli, Costa, Rarelitz & Rosenfeld (1964), for example, found that the more cries the neonate made in response to flicks, the higher was the Stanford and Binet IQ score at age three. Similarly, Lewis (1967) found that those infants who cried most in response to withdrawal of the nipple during feedings at one month were at one year the ones most likely to adopt a problem-solving approach to obtaining toys placed behind a barrier.

Although no systematic testing of infants was undertaken in the present study there did seem to be a tendency for those infants who cried most to reach developmental milestones such as sitting and crawling sooner than more placid infants. This is an area where further study would be fruitful.

7.13 Conclusions

The central problem in studying any area of child development is that of finding order in change, of "identifying continuities in behavioural systems that are rapidly transforming and reorganizing" (Lewis and Starr, 1979, p. 653). Generally speaking, there has been little attention to or success in addressing this question. It is not clear to what extent the abilities or characteristics of the child at one point in time are related to abilities and characteristics at another (Wohlwill, 1973). Nor is the relationship between these characteristics and the infant's social environment well established. The main concern of the present investigation has been to establish the degree of continuity and

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In attempting to determine the extent to which characteristics at one point in development are related to those at another, it is necessary to consider four major issues (Lewis and Starr, 1979): (a) response reliability and measurement, (b) multiple response attributes, (c) response meaning and organisation, and (d) the extent to which any continuity observed is a characteristic of the infant or of the infant-environment system.

(a) Reliability of measures

Before it can be concluded that continuity or change has been identified, it is necessary to ascertain whether the initial measures of the behaviour of interest are, in fact, stable. Causes of unreliability may range from the failure of the researcher to standardise the conditions of observation through to the possibility that infants are not consistent in their reactions. In this study the former criticism does not apply since the observation conditions were standardised and there was a high level of inter-observer agreement. In addition, comparable estimates of hourly crying rates were obtained from observations and maternal diaries. Since the diaries were completed by the mothers on alternate days during the week preceding observation, this finding indicates that there was also considerable short-term reliability in the measures used. Each infant studied produced much the same amount of crying over the week-long period, indicating that the amount of crying in the home environment has the requisite short-term stability necessary for investigating developmental continuity.

(b) Response attributes

A second and related issue is that of the response attributes measured. Each response selected as an index of the characteristic or function under investigation will be fairly arbitrarily defined by the hypotheses of the investigator. As Lewis and Starr (1979) have suggested, it may be that measuring the stability of a particular response over time depends partly on those attributes of the response selected for measurement. Thus it is important to measure as many attributes as possible. These attributes may include quantity, quality, speed of acquisition, organisational properties and intention, the latter referring to the infant's control of the response and awareness of that control. In this study an effort was made to characterise crying in terms of a number of dimensions rather than using a single attribute. Crying was measured both in terms of the quantity and quality, the latter indicated by the distinction made between fusses and cries. An attempt was also made to determine the circumstances in which crying occurred and the way these related to the type of fuss-cry events exhibited. Furthermore, crying was not examined as an isolated event but was related to other social responses in the infant's repertoire.

(c) Response meaning and organisation

The need to examine a number of dimensions of the response of interest is underlined by the problem of response meaning and organisation. The assumption which underlies many studies of continuity in infant development is that responses measured at two points in time are strongly related. However, as Kagan (1971) has argued, this assumption may not be justified. Although the response may be topographically similar on two different occasions, the meaning of that response may have changed. It is then important to consider the relationship of the response to the process or construct of which it is said to be an indicator. In Kagan's terminology, there may be homotypic continuity, where the response remains stable but the process controlling the response has changed; heterotypic continuity, where the process has remained stable but the expression of that process has changed, and complete continuity, where both process and behaviour are stable.

In the present investigation the amount of crying was a highly stable characteristic over the six months of observation. Although crying was not hypothesized to be an index of any higher level process it may be that it does represent a more general construct such as attachment. This is the view favoured by Bell and Ainsworth (1972) who have argued that crying is the earliest emerging of the 'attachment' behaviours which have evolved to ensure close protective contact with caregivers. The fact that infants in this study were found to cry upon loss of contact with the mother (although this was obviously only one of many events found to precede cries) does offer some support of this view. However, the diminished success at six months of maternal responses which restored that contact suggests that the meaning of cries elicited by loss of contact may have changed. Infants of this age were often successfully soothed only after more active stimulation by the mother. This, together with the fact that frequent crying at six months was associated with increased sociability in the infant, suggests the homotypic continuity outlined by Kagan. Crying at two weeks and three months may have represented an attempt to restore close protective contact since in Bowlby's terms being alone is a "natural clue to danger". Later the crying seemed intended to involve the mother in stimulating social interaction, not simply to regain contact with and proximity to her.

Other interpretations of the meaning of cries are suggested by the apparently close relationship between the amount of crying and the amount of the social behaviours of smiling, vocalizing and looking at the mother. Those infants who cried a lot were at six months the most sociable. Furthermore, a greater proportion of their cries were precipitated by loss of contact with the mother. When viewed in this context, crying may be seen as an early index of sociability. As suggested earlier, it may also be that the amount of crying in the young infant reflects an active problem-solving response to distressing and frustrating circumstances. As Lewis pointed out, crying at one month in response to frustration is an adaptive and active behaviour whereas at 12 months it represents a passive, and probably ineffectual, response.

(d) Sources of continuity

Finally, it is important to establish whether any continuity observed is endogenous - residing in processes within the organism - or exogenous - residing in the environment and resulting from early experiences, particularly with caretakers. The causal modelling undertaken in this study was designed to disentangle the contributions of these two processes. The results showed that maternal behaviour in response to cries did not affect the amount of crying shown by the infant. Rather, mothers systematically modified their behaviour as a function of infant crying. However, it is possible that other characteristics of the social environment not measured in this investigation were responsible for the stability observed, although mothers who ignored a high proportion of cries did not appear to differ from more responsive mothers in terms of the quantity and quality of their interaction with their infants. It seems more likely that the amount of crying represents a stable, reasonably fixed characteristic at least over the first six months.

7.14 Suggestions for Future Research

The reasons for the considerable individual differences in the amount of crying remain to be determined. In particular, while the crude analysis of the contribution of birth variables to the amount of crying indicated that they were not important, further systematic investigation of the mothers' physical and psychological well-being during pregnancy and the circimstances of labour and delivery are necessary before firm conclusions can be drawn. Other studies (Richards & Bermal, 1972; Standly *et al.*, 1978; Yang *et al.*, 1976) have suggested that these variables do make a significant contribution although such studies have typically examined the amount of crying elicited by standardized test procedures rather than the amount of spontaneously occurring crying in the home environment. This is particularly important since the one study which has investigated the relationship between elicted crying on the Brazelton assessment procedure and crying at home later on failed to find any association between the two indices (Fish and Crockenberg, 1981).

In addition it may be that maternal behaviour does affect the amount of crying shown by the infant at extreme levels of unresponsiveness not sampled in the present study. It would be of some interest to sample such levels, possibly by widening selection criteria to include for study women who might be considered "at risk" for disturbances in mothering behaviour, e.g. young, unmarried, low socio-economic status mothers.

Finally, the relationship between crying and other infant characteristics and abilities, especially in the long-term, requires further investigation. Data from the present study indicate that crying may be related to later infant sociability and intellectual ability. It is planned to follow up infants studied in the present investigation to determine their performance on tests of language and general intellectual functioning during the pre-school period.

APPENDICES

APPENDIX 1

Subject Details

Age

	Median	Range
Mothers	26.1	23-32
Fathers	30.3	24-41

Occupation

	Professional	Administrative	Clerical	Sales	Trades
Mothers	24	6	17	7	-
Fathers	27	16	8	2	-

Education

	4th Year High School	5th Year High School	Trade Certificate or Diploma	1 or more years tertiary	Completed tertiary	Post-graduate
Mothers	12	7	1	13	19	2
Fathers	9	13	7	6	14	5

Combined Income

10,000-14,999	8
15,000-19,999	24
20,000-29,999	11
30,000 and over	5
Not disclosed	6

APPENDIX 2

Pregnancy Questionnaire

1. Prior to this pregnancy, how was your overall health?

   Very good _____ Good _____ Not so good _____ Poor _____

2. Generally, how have you been feeling during your pregnancy?

   Very well _____ Well _____ Not so well _____ Quite sick _____

3. The following are some common complaints of pregnancy. Please indicate which of them has bothered you and how much it has.

	Not at all	A little	Quite a bit	A great deal
Nausea or vomiting	_____	_____	_____	_____
Tiredness	_____	_____	_____	_____
Backache	_____	_____	_____	_____
Heartburn	_____	_____	_____	_____
Leg pains, varicose veins	_____	_____	_____	_____
Rapid weight gain	_____	_____	_____	_____
Sudden mood changes (e.g. feeling fine one moment and crying the next)	_____	_____	_____	_____
Depression or feelings of unhappiness	_____	_____	_____	_____
Water retention and swelling	_____	_____	_____	_____
Sleeplessness	_____	_____	_____	_____

4. Overall, have you experienced much discomfort during the pregnancy?

   A great deal _____ A moderate amount _____ A little _____ None at all _____

5. Please indicate whether or not your pregnancy has been disruptive:

	Very disruptive	Moderately disruptive	Only slightly disruptive	Not at all disruptive
a. to your usual work	_____	_____	_____	_____
b. to your social life	_____	_____	_____	_____
c. to your relationship with your husband	_____	_____	_____	_____

6. When you found out you were pregnant, how did you feel?

   Very pleased _____ Pleased _____ Displeased _____ Very displeased _____

7. How do you feel <u>now</u> about being pregnant?

   Very satisfied _____ Satisfied _____ Dissatisfied _____ Very dissatisfied _____

8. The following are worries women sometimes have during pregnancy. Please indicate which of them has bothered you and how much it has.

	Very often worried	Sometimes worried	Hardly ever worried	Never worried
My physical appearance	_____	_____	_____	_____
What childbirth will be like	_____	_____	_____	_____
Gaining weight	_____	_____	_____	_____
Being able to take care of the baby	_____	_____	_____	_____
Whether the baby will be normal and healthy	_____	_____	_____	_____
Being able to continue my own activities after the baby is born (work etc.)	_____	_____	_____	_____
How my husband feels towards me	_____	_____	_____	_____
Not being sure I want the baby	_____	_____	_____	_____
The pain of child-birth	_____	_____	_____	_____
Financial problems	_____	_____	_____	_____

9. How painful do you expect the labour and delivery to be?

Painful _____ Moderately painful _____ Only a little painful _____ Not at all painful _____

10. Have you experienced any unusually stressful or unpleasant events during your pregnancy, such as losing a job, shifting house, illness or death of someone close to you?

YES _____ NO _____

If YES please indicate what happened. ________________________

____

11. Are you undertaking any particular preparation for childbirth? e.g. classes

YES _____ NO _____

If YES please indicate what. ________________________

____

12. Do you want to have any drugs or medication for pain relief during the labour?

Definitely not	Would prefer not to	Would have some if staff think it necessary	Would definitely like to have some
_____	_____	_____	_____

13. Sometimes it is necessary to carry out certain procedures for medical reasons. Please indicate how you would feel if you needed to have any of the ones listed.

	Very dis-appointed	Moderately dis-appointed	Only a little dis-appointed	Not at all dis-appointed
induction of labour	_____	_____	_____	_____
caesarian section	_____	_____	_____	_____
instrumental delivery of the baby (e.g. forceps or vacuum extraction	_____	_____	_____	_____
general anaesthetic	_____	_____	_____	_____

14. Do you have any specific plans about what posture to adopt during labour and delivery?

YES _____ NO _____

If YES, give details ______________________________

15. Is your husband planning to be present during the labour and delivery?

YES	definitely	_____
	perhaps	_____
NO	not at all	_____

16. Do you want any special procedures to be followed during and after the birth? For example, breast feeding immediately after birth.

YES _____ NO _____

If YES please describe what you would like ______________________________

____

17. Do you plan to breast feed or bottle feed?

breast _____ bottle _____

18. Would you like to have the baby room in with you or would you prefer it to be kept in the nursery most of the time?

Room in both day & night ___	Room in except at night ___	Baby kept in nursery ___

19. How confident are you that your wishes about these procedures will be respected?

Very confident ___	Moderately confident ___	Only a little confident ___	Not at all confident ___

20. Would you like this baby to be a girl or a boy?

___ GIRL

___ BOY

___ NO PREFERENCE

21. What is your age? ___________

22. What is your husband's age? ___________

23. Before this pregnancy, were you (TICK WHICHEVER ONES APPLY)

a housewife, full-time ___

in paid work part-time or ___

full-time ___

studying part-time or ___

full-time ___

24. What is/or was your most recent occupation? ____________________

25. What is your husband's occupation? ____________________

26. What was the last level of education you completed?

___ 2nd year high school or less

___ 3rd year high school

___ 4th year high school

___ 5th year high school

___ Trade certificate or diploma

___ 1 or more years of tertiary education

___ completed university degree or other tertiary qualification

___ postgraduate course (Ph.D., Masters, Dip.Ed. etc.)

27. What was the last level of education your husband completed?

_____ 2nd year high school or less

_____ 3rd year high school

_____ 4th year high school

_____ 5th year high school

_____ Trade certificate or diploma

_____ 1 or more years of tertiary education

_____ completed university degree or other tertiary qualification

_____ postgraduate course (Ph.D., Masters, Dip.Ed. etc.)

28. Please mark the category that is closest to your yearly income.

$	$	HUSBAND	SELF
a. less than	5,000	_____	_____
b. 5,000 -	6,999	_____	_____
c. 7,000 -	9,999	_____	_____
d. 10,000 -	14,999	_____	_____
e. 15,000 -	19,999	_____	_____
f. 20,000 -	29,999	_____	_____
f. 30,000 -	or over	_____	_____

QUESTIONNAIRE FOR EXPECTANT MOTHERS

The following statements refer to matters which are of interest and concern to mothers. Not all mothers feel the same way about them. We would like to find out what your opinions are.

Please read each statement carefully and decide to what extent you agree or disagree with it:

1	2	3	4	5	6
Strongly agree	Moderately agree	Slightly agree	Slightly disagree	Moderately disagree	Strongly disagree

For each statement circle the number on the left hand column which shows the way you feel.

Example

1 2 3 4 5 6 Parents have no difficulties in bringing up children.

---

1 2 3 4 5 6 When the baby is born he (she) already has a personality of his (her) own.

1 2 3 4 5 6 Holding and caressing a baby when he (she) cries is good for him (her).

1 2 3 4 5 6 A newborn baby doesn't cry unless something is wrong.

1 2 3 4 5 6 Newborn babies are fragile and delicate.

1 2 3 4 5 6 Newborn babies must be handled extremely carefully.

1 2 3 4 5 6 A mother just naturally knows when to pick up a crying baby.

1 2 3 4 5 6 Taking care of a baby is much more work than pleasure.

1 2 3 4 5 6 A mother doesn't really think of her baby as a person until it begins to smile and recognise people.

1 2 3 4 5 6 It is a terribly frustrating task to care for a newborn infant.

1 Strongly agree	2 Moderately agree	3 Slightly agree	4 Slightly disagree	5 Moderately disagree	6 Strongly disagree

1 2 3 4 5 6 A newborn baby can't let you know what he (she) needs.

1 2 3 4 5 6 Mothers enjoy breast feeding much more than bottle feeding.

1 2 3 4 5 6 A mother and her five month old child should be able to understand each other fairly well.

1 2 3 4 5 6 Infants should be kept on a regular feeding schedule and should be fed only at certain times.

1 2 3 4 5 6 When a child cries, his (her) mother should comfort him (her).

1 2 3 4 5 6 Infants under five months of age are not very good at amusing themselves.

1 2 3 4 5 6 Infants like a lot of adult attention.

1 2 3 4 5 6 If a baby's cries are ignored this will make him (her) cry more.

1 2 3 4 5 6 If a baby seldom smiles or coos it's because his (her) mother doesn't play with him (her) enough.

1 2 3 4 5 6 Too long feeding at the breast is likely to make the baby too dependent on the mother.

1 2 3 4 5 6 Newborn babies are much more like each other than they are different from each other.

1 2 3 4 5 6 Babies are frequently so demanding that their mothers have no time for anything else.

1 2 3 4 5 6 Most of the time small babies don't notice when their mothers smile at them.

1 2 3 4 5 6 Boy babies can be expected to cry less than girl babies.

1	2	3	4	5	6
Strongly agree	Moderately agree	Slightly agree	Slightly disagree	Moderately disagree	Strongly disagree

1 2 3 4 5 6 The six-month-old baby can tell you exactly what he (she) wants if you watch and listen.

1 2 3 4 5 6 Regardless of their age, babies sometimes seem to be lonely and unhappy.

1 2 3 4 5 6 A six-month-old baby should be picked up when he (she) cries.

1 2 3 4 5 6 Preventing a child from sucking his (her) thumb when he (she) wants may be bad for the child.

1 2 3 4 5 6 Feeding at the breast is more satisfying for a child than feeding from the bottle.

1 2 3 4 5 6 If a mother plays a lot with her baby he (she) will want her to be around all the time.

1 2 3 4 5 6 A child should not be permitted to cry.

1 2 3 4 5 6 A mother gets physical pleasure out of holding, hugging, and kissing her child.

1 2 3 4 5 6 Babies need love and attention, but not nearly as much as most mothers give them.

1 2 3 4 5 6 Mothers should ignore their child's crying when it is just for attention.

1 2 3 4 5 6 A child should be weaned as early as possible, even though he (she) may protest somewhat.

1 2 3 4 5 6 Little boys can be expected to cry just as much as little girls.

1 2 3 4 5 6 It is never too early to start teaching a child to obey commands.

1	2	3	4	5	6
Strongly agree	Moderately agree	Slightly agree	Slightly disagree	Moderately disagree	Strongly disagree

1 2 3 4 5 6 A child should be fed when he (she) is hungry.

1 2 3 4 5 6 Children should be allowed to express their anger as well as their more pleasant feelings.

1 2 3 4 5 6 If mothers do not ignore some of the baby's cries, the baby will learn to cry just to get attention.

1 2 3 4 5 6 Little boys are naturally tougher than little girls.

1 2 3 4 5 6 Parents prefer quiet children to active ones.

1 2 3 4 5 6 Parents should be careful not to make any distinctions between what they expect of their little girls and their little boys.

1 2 3 4 5 6 It is easy to tell when a child is crying for attention.

APPENDIX 3

FAMILY NAME ______________________ BABY'S NAME ______________________

DATE ______________________ BABY'S AGE ______________________

12.15 12.30 12.45	1.15 1.30 1.45	2.15 2.30 2.45	3.15 3.30 3.45	4.15 4.30 4.45	5.15 5.30 5.45
1.00 a.m.	2.00 a.m.	3.00 a.m.	4.00 a.m.	5.00 a.m.	6.00 a.m.
7.00 a.m.	8.00 a.m.	9.00 a.m.	10.00 a.m.	11.00 a.m.	12.00 a.m.
1.00 p.m.	2.00 p.m.	3,00 p.m.	4.00 p.m.	5.00 p.m.	6.00 p.m.
7.00 p.m.	8.00 p.m.	9.00 p.m.	10.00 p.m.	11.00 p.m.	12.00 MIDNIGHT

The smallest line represents five minutes. Please use the following symbols to indicate what the baby is doing at each time:

Baby asleep _____
Baby awake -----
(but not being fed & not crying)
Baby crying . . . . .
Baby being fed /////////
Not sure ?????????

APPENDIX 4

CODING MANUAL

1. Observer Strategies

1.1 An observer must be as objective as possible, i.e., assumptions or inferences regarding motivation or intent should be avoided.

1.2 Observers should record rapidly according to the decision rules outlined in this manual.

1.3 The observer should attempt to be as unobtrusive as possible and should keep eye contact, gestures and talking to a minimum.

1.4 All approaches directed to the observer should be ignored, as far as is politely possible. Mothers have agreed in advance of observation to avoid interacting with the observer, so this will not be as difficult as it might seem.

1.5 Do not use furniture that is likely to be used by the mother. Always place yourself in a position where you can see the baby, who is the main target of observation.

1.6 If your location is too far away to hear or see, move to another location as unobtrusively as possible.

1.7 Observers should not discuss the people observed except in connection with the conduct of the research. Names and identifying information should be carefully concealed and deleted from the computer record. Only code numbers for the targets should accompany data collected and compiled in the field.

2. Data Identification

2.1 Target:

Each target (i.e., the child being tracked) will be allotted a number from 01 to 60. This should be recorded on a master sheet and when recording data identification.

2.2 Rating Occasion:

There will be two series of eight seven minute ranging periods separated by a 10 minute rest period. Each rating occasion will be numbered from 1 to X depending on the number of rating periods finally conducted.

2.3 Date:

This refers to the calendar date which should be recorded numerically, e.g., 6/6/78.

2.4 Time:

Time of commencement of observation periods should be accurately recorded including any breaks from the scheduled observation.

2.5 Location:

Each location in the house will be allotted a number, which should be entered on the Data Identification sheet. These are as follows:

Location	Number
Kitchen	1
Family Room	2
Lounge	3
Dining Room	4
Baby's Bedroom	5
Bathroom	6
Outside	7
Other. Specify ____________	8

2.6 Location of Mother:

At the commencement of coding indicate whether the mother is in a position to interact with the baby by using the following code.

In another room or area	1
In the same room (within the visual range of the infant)	2
In the same room (not within the visual field of the infant)	3

MOTHER - INFANT INTERACTION CODING SYSTEM (Birth to 6 months)

Note: Codes indicated by an asterisk apply only to the six month observation.

Infant Codes

A. State:

01. Drowsy state (DS)

Baby is still and quiet, intermittently opening and closing eyes, which may have a dull unfocused appearance. Breathing may be irregular and mild startles may be observed.

Note: If baby actually falls asleep then coding should cease until baby awakens again.

02. Fusses (FS)

Baby fusses, frets, whimpers or whines. The important features are low-intensity, non-rhythmic nasal or strangulated sounds associated with a pucker face and of varying duration. Record each cluster of sounds as continuous unless more than three seconds elapses between vocalizations. This should be distinguished from a full-blown, enduring cry.

03. Cries (CR)

A cry is an intense, rhythmic vocalization associated with pucker face and, except in neonates, tears. It may or may not be accompanied by diffuse motor activity and the infant's face may redden.

B. Oral Activity:

04. Eats (ET)

Baby is feeding from a breast, bottle, cup, spoon or fingers. Include instances when the baby takes fluid from a container which is propped up without being held by the infant.

05. Sucks (SU)

Baby sucks or mouths anything except during feeding, (e.g. finger, dummy, ring or toy i.e. an object, or body part, is placed between lips and tongue and then licked, or sucked or bitten. Include those occasions when baby makes sucking movements although there is nothing in the mouth.

06. Avoids Feed (VF)

Baby closes its mouth, averts its face and/or twists its body or pushes away from food offered directly into its mouth by any means. Include cases in which the child actively pushes away the proferred breast, bottle, spoon etc.

07. Coughs (CS)

Baby burps, coughs, sneezes, gags, hiccoughs, or spits up food or saliva.

C. Attention:

08. Attends (AT)

Baby looks at mother.

Note: The baby's head and eyes may be oriented toward any part of the mother not only the head and eyes.

09. Looks at Object (LK)

Baby's eyes are directed toward and/or following a toy, object, mother's finger or other physical stimulus. Do not include undirected gazing which should be coded as 10, self-involved (SI).

10. Self-Involved (SI)

Baby is clearly awake, but without an apparent outside focus of interest. Include undirected gazing and looking at parts of own body, e.g. hands and feet.

D. Tactual and Motor Activity:

11. Startles (ST)

Baby clearly startles probably in response to a loud noise or sudden stimulation. Record only those instances where there is total body movement.

12a. Moves (MV)

Baby moves i.e. alternately extends and flexes arms and/or legs for a period longer than 3 seconds. Include instances where baby moves from one position to another e.g. by rolling over.

*12b. Moves (MV)

Baby moves by him/herself for a distance of one foot or more by any means including rolling over, crawling or pulling along on chairs or other objects.

*13. Approaches (AS)

Baby crawls or otherwise propells him/herself towards the mother, reducing the distance between them.

*14. Climbs (CL)

Starting from the floor or some other surface baby climbs or attempts to climb onto mother's lap, or climbs or attempts to climb on her in any way.

*15. Gets down (GD)

Baby gets down or attempts to get down from the mother's lap or from her arms i.e. baby manouevers from a position in which his/her weight is fully supported by the mother into a position such that she/he is fully or almost fully supported on the floor or some other surface.

*16. Crash (SH)

Baby loses control of posture and falls forward, backwards, or to one side. Some part of the body will contact floor, objects or persons and baby may reach out with hands or arms to cushion the fall.

17. Touches (TC)

Baby's hand contacts any part of the mother (including clothes) with no or only very small non-rhythmical irregular movements. Include clinging when baby's hands and fingers are flexed, enclosing part of mother's body or clothing.

18. Touches Object (TO)

Baby holds or touches toy or other object. Include occasions when baby makes any contact with a toy or other object, whether with hand or foot.

19. Shakes or Bangs Object (SB)

Baby shakes or bangs an object repeatedly and produces noise e.g. shake or rattle.

E. Expressive/Social:

20. Smiles or Laughs at Mother (SM)

Smile refers to all expressions of the face in which the mouth corners are retracted or raised so that an imaginary line connecting them would fall nearer to the upper than the lower lip. The mouth may be open or closed. Include only those instances when baby smiles while looking toward the mother. Record only clearly distinguishable smiles. Laughing refers to an open-mouthed smile with audible vocalization of a rapid staccato quality. The baby is looking at the mother while laughing or laughs in response to her tickling, laughing or playing games such as peek-a-boo.

21. Smiles or Laughs at Toy/Object (LO)

Baby smiles or laughs while looking at or playing with toys or other objects.

22. Frowns (FR)

Baby frowns, i.e. brow is wrinkled and eyebrows are drawn inward and down. The mouth may also be drawn and the lips pouted.

23. Vocalizes (VC)

Baby emits any distinct vocalization which cannot be coded as fuss (FS), cry (CR), or laugh (LA). Example: Baby coos, hums or gurgles.

*24. Offer Toy/Object (OT)

Baby holds out a toy or other object towards the mother. The baby should be clearly holding the object toward the mother and looking at her.

*25. Takes (TK)

Baby attempts to remove an object from mother's grasp or from her clothing. She/he may or may not succeed in gaining possession and if mother maintains grasp, a tug-o-war will result.

*26. Attacks (AK)

Baby hits, pushes, bites, pulls hair or otherwise appears to attack mother. Distinguish this from play fighting which will normally be accompanied by smiling and laughing.

Mother Codes

A. Feeding:

01. Feeds (FE)

Mother puts nipple of breast or bottle, spoon or cup into baby's mouth. Code as continuous unless interrupted for more than three seconds or if mother engages in further behaviour appropriately described using another code.

02. Stimulates/Adjust Feeding (SF)

Mother moves nipple, bottle or finger to and fro or backwards and forwards inside baby's mouth. Alternatively, mother makes repeated small movements of finger on the side of baby's cheek in the feeding context. Also include instances when mother adjusts or changes the position of the nipple or bottle to improve the flow of milk.

03. 'London' burping procedure (BP)

Baby is leaned forward and supported by the neck, chest or jaw with one hand, and patted or rubbed on the back with the other. Alternatively, baby is supported against mother's shoulder and rubbed or patted on the back.

B. Holding:

04. Holds Toward (HF)

Mother supports the weight of baby so baby is able to see her face. Examples:

i. Holds baby on knee facing towards her,
ii. Holds baby against shoulder,
iii. Cradles baby in her arms.

05. Holds Away (HA)

Mother supports the baby's weight so that she/he is facing away from her. Examples:

i. Baby is held on knee facing away from mother,
ii. Baby is carried on mother's back.

06. Adjusts Hold (AJ)

Mother shifts or adjusts baby's position during one of the above holding positions i.e. she alters the orientation and/or trunk contact aspects of the hold.

07. Puts Down (PD)

Mother stops holding or carrying the baby and puts baby down into an area or onto an object rather than to another person.

08. Carry (CY)

Mother holds baby in her arms and moves from one location to another.

09. Walks (WL)

Mother walks up and down or paces with baby for stimulation or soothing, not simply to transport baby from one location to another. Include instances when the baby is pushed in a pram or stroller.

10. Rocks (RK)

Mother moves baby backwards and forwards or side to side with rhythmic movements ranging from gentle rocking to fairly vigorous bouncing. Include instances when the mother is holding the baby and rocks her own body from side to side or back and forth. Also include occasions when baby is rocked while not in mother's arms, e.g. in bouncer or crib.

C. Tactual Stimulation:

11. Offers Dummy/Pacifier (OD)

Mother places dummy or other pacifier (e.g., teething ring) or finger into baby's mouth. Include any movement of the pacifier by mother in and around the baby's mouth.

12. Offers Toy/Object (OT)

Mother offers or gives a toy or other object to the baby by holding it towards him/her or placing it in his/her hand. Mother must be looking at baby and/or expressing the intention of offering the object.

13. Affectionate Physical Contact (AF)

Mother pats, strokes, hugs, kisses or cuddles baby. Use only when the physical contact is not for specific caretaking like burping or wiping.

14. Tickles (TK)

Large sudden or rapid movements of the hand or fingers on a part of the baby's body. The fingers are usually placed on baby's body and then wriggled and/or squeezed lightly. Objects may be used for the same purpose.

D. Expressive/Social

15. Smiles/Laughs (LA)

Use whenever the mother smiles or laughs while focusing on the baby. Record each burst of laughter or cluster of chuckles as continuous unless interrupted for longer than two seconds.

16. Sings (SN)

Mother sings or chants to the baby. For example:

i. Sings a lullaby,
ii. Repeats a noise, word or phrase several times in a rhythmic, chanting fashion.

17. Yells (YE)

Mother yells, shouts or talks very loudly and emphatically, and her orientation is clearly towards the baby.

18. Approves (AP)

Mother clearly indicates by words or gestures directed toward baby that she approves of baby's behaviour and/or characteristics. Examples:

i. "That's a good girl",
ii. "What a lovely smile".

19. Disapproves (DI)

Mother indicates by words, facial expression, gesture or tone of voice directed toward baby that she disapproves of baby's behaviour and/or characteristics. Examples:

i. Shaking head or index finger,
ii. Statements like "that's not nice",
iii. Frowning directly at the child,
iv. Statements delivered in negative or irritable tones.

20. Imitates (MM)

Mother imitates or mimes baby's facial expressions, gestures or vocalizations, e.g. a frown or a gurgle.

*21. Demonstrates (DM)

Mother shows baby how to do or say something by providing an example of the action or speech to be performed. Examples:

i. Shows baby how to hold a spoon,
ii. Points to an object and names it,

22. Play/Entertains (PL)

Mother plays with or entertains baby. For example, mother:

i. Holds baby by midriff and swings baby backwards and forwards,
ii. Rattles a toy or plays peek-a-boo,
iii. Tickles or touches baby with a toy or other object not for purpose of caretaking,
iv. Makes a face at baby.

23. Attends (AT)

Mother looks at baby. Eye contact may or may not be evident, i.e. baby need not be looking at mother.

24. Talks (TL)

Mother talks to baby in a way which cannot be coded using the more specific codes. Example: Mother gurgles at baby. Mother describes what she is doing or asks questions of baby e.g. "Do you want me to tickle you?".

E. Caretaking/Discipline:

25. Commands (CM)

Mothers gives a direct, clearly stated command to the baby to do or stop doing something. Include instances when mother calls baby's name in an apparent attempt to direct baby's attention to her. Examples:

i. "Don't touch",
ii. "Be careful",
iii. "Hey, Johnny, look".

26. Negative Command (CN)

This is an explicit command delivered in a firm voice and which has one or more of the following characteristics:

(a) Immediate compliance is demanded;
(b) Unpleasant consequences are implicitly or explicitly threatened;
(c) Sarcasm or humiliation are directed at the recipient of the command.

Examples:

i. "Stop that, at once",
ii. "Stop or I'll slap you".

27. Restrain/Prohibit (RP)

Mother physically stops baby from doing something or holds or moves baby or any part of baby in order to control or change the baby's activity. Include instances when mother takes an object from baby when it has not been offered to her. Examples:

i. Mother holds baby's arms so baby cannot reach for an object,
ii. Mothers moves baby bodily away from harmful object.

28. Physical Punishment (PN)

Mother makes physical contact with baby with sufficient force to inflict pain or to shock. Include slaps, hits, bites, punches etc.

29. General Caretaking (GC)

Mother engages in routine caretaking activities such as cleaning, bathing or drying baby, changing baby's nappy, adjusting baby's clothes or covers, or adjusting baby's position when baby is not being held.

Spatial Location

30. Approaches (AS)

Mother moves into the infant's field of vision. Examples:

i. Moves from behind the infant to the front,

ii. Comes from another area to the area where the baby is sitting,

iii. If baby is supine and the range of vision is restricted by the sides of a cot, pram etc., indicate when the mother is in a position to be seen by baby.

31. Moves Away (MA)

Mother moves into a position where it seems the infant can no longer see her e.g. moves behind the infant, goes into another room, steps away from the cot.

32. No Input (NI)

The mother is not interacting with the baby in any way.

APPENDIX 5

ANOVA results (sex x age with repeated measures) for:

(i) frequency of fusses;

(ii) frequency of cries;

(iii) frequency of cry signals;

(iv) duration of fusses;

(v) duration of cries; and

(vi) sex x age x type of record for hourly rates of combined fussing and crying.

(i) Frequency of Fusses

VARIANCE TABLE

SOURCE	DF	MS	F	P
Between Subjects	53			
A (sex)	1	122.723	1.791	NS
Subjects within groups	52	68.505		
Within Subjects	108			
B (age)	2	16.154	1.035	NS
AB	2	6.057	0.388	NS
BX subjects within groups	104	15.611		

(ii) Frequency of Cries

VARIANCE TABLE

SOURCE	DF	MS	F	P
Between Subjects	53			
A (sex)	1	501.391	2.390	NS
Subjects within groups	52	209.813		
Within Subjects	108			
B (age)	2	1775.352	66.403	<.001
AB	2	32.020	1.198	NS
BX Subjects within groups	104	26.736		

(iii) Frequency of Cry Sequences

VARIANCE TABLE

SOURCE	DF	MS	F	P
Between Subjects	53			
A (sex)	1	154.312	2.124	NS
Subjects within groups	52	73.122		
Within Subjects	108			
B (age)	2	267.142	6.932	<.01
AB	2	55.185	1.423	NS
BX subjects within groups	104	38.537		

(iv) Duration of Fusses

VARIANCE TABLE

SOURCE	DF	MS	F	P
Between Subjects	53			
A (sex)	1	5.015	1.087	NS
Subjects within groups	52	4.612		
Within Subjects	108			
B (age)	2	2.219	1.980	NS
AB	2	1.028	0.917	NS
BX subjects within groups	104	1.121		

(v) Duration of Cries

VARIANCE TABLE

SOURCE	DF	MS	F	P
Between Subjects	53			
A (sex)	1	642.781	1.493	NS
Subjects within groups	52	430.399		
Within Subjects	108			
B (age)	2	1040.680	7.699	<.001
AB	2	328.555	2.431	NS
BX subjects within groups	104	135.163		

(vi) Hourly Rates of Combined Fussing and Crying

VARIANCE TABLE

SOURCE	DF	MS	F	P
Between Subjects	53			
A (sex)	1	122.592	1.639	NS
Subjects within groups	52	74.818		
Within Subjects	270			
B (age)	2	297.354	24.621	<.001
AB	2	30.056	2.489	NS
BX subjects within groups	104	12.077		
C (record)	1	2.402	0.661	NS
AC	1	9.169	2.522	NS
CX subjects within groups	52	3.636		
BXC	2	15.277	6.590	<.01
AXBXC	2	0.643	0.277	NS
BXCX subjects within groups	104	2.318		

(vii) % Interaction Time spent Smiling, Vocalising and Looking at Mother

VARIANCE TABLE

SOURCE	DF	MS	F	P
Between Subjects	53			
A (sex)	1	197.223	2.634	NS
Subjects within groups	52	74.875		
Within Subjects	108			
B (age)	2	577.142	11.421	<.001
AB	2	21.079	0.417	NS
BX subjects within group	104	50.533		

(vii) Probability of Smiling, Vocalising and Looking Following Maternal Behaviour

VARIANCE TABLE

SOURCE	DF	MS	F	P
Between Subjects	53			
A (sex)	1	723.618	2.103	NS
Subjects within groups	52	344.088		
Within Subjects	108			
B (age)	2	1647.017	8.162	p<.001
AB	2	311.642	1.544	NS
BX Subjects within groups	104	201.791		

APPENDIX 6

ANOVA results (sex of infant x age of infant with repeated measures) for:

(i) Arcsin transformed percentages of maternal response to cries;

(ii) Mean duration to maternal response;

(iii) Percentage of observation time (Arcsin transformed) mothers spent in interaction with infants;

(iv) Percentage of positive maternal responses during interaction (Arcsin transformed);

(v) Probability of smiling and vocalising following infant behaviour (Arcsin transformed).

(i) Percent Responses to Cries

SOURCE	DF	MS	F	P
Between subjects	53			
A (sex)	1	471.262	1.142	NS
Subjects within group	52	331.874		
Within Subjects	108			
B (age)	2	789.043	21.174	<.001
AB	2	46.154	1.238	NS
B x subjects within groups	104	37.265		

(ii) Duration to Respond

SOURCE	DF	MS	F	P
Between subjects	53	17.014		
A (sex)	1	8.041	2.116	NS
Subjects within groups	52			
Within subjects	108			
B (age)	2	57.442	6.913	p<.01
AB	2	40.855	4.917	p<.05
B x subjects within groups	104	8.309		

(iii) Percent Observation Time in Interaction

SOURCE	DF	MS	F	P
Between subjects	53			
A (sex)	1	78.278	3.412	NS
Subjects within groups	52	22.941		
Within subjects	108			
B (age)	2	654.457	5.622	<.01
AB	2	804.386	6.910	<.01
B x subjects within groups	104	116.409		

(iv) Percent Positive Responses

SOURCE	DF	MS	F	P
Between subjects	53			
A (sex)	1	78.443	1.016	NS
Subjects within groups	52	77.208		
Within subjects	108			
B (age)	2	246.011	5.824	<.01
AB	2	99.163	2.346	NS
B x subjects within groups	104	42.269		

(v) Probability of Smiling and Vocalising Following Infant Behaviour

SOURCE	DF	MS	F	P
Between subjects	53			
A (sex)	1	46.782	1.023	NS
Subjects within groups	52	45.730		
Within subjects	108			
B (age)	2	271.420	3.402	NS
AB	2	145.442	1.823	NS
B x subjects within group	104	79.782		

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