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The Impact of Cries of High- and Low-Complications Preterm and Fullterm Infants on Mothers and Nonmothers: Perceived Characteristics and Psychophysiological Reactivity

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ABSTRACT

The Impact of Cries of High- and Low-Complications Preterm and Fullterm Infants on Mothers and Nonmothers: Perceived Characteristics and Psychophysiological Reactivity

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Concordia University, 1986

The effect of cries of infants of varying medical risk status upon maternal subjective and psychophysiological response was examined in two experiments. In Experiment 1, responses of mothers and nonmothers to recordings of the spontaneous cries of high- and low-complications preterm and fullterm infants, and control coos were investigated. Subjects rated vocalizations on cry characteristics, and selected a caregiving response, as well as provided a measure of subjective arousal. Heart rate and blood pressure readings were obtained. Cries differed from coos; they elicited different heart rate and blood pressure changes, induced feelings of increased arousal and were rated less favourably. Preterm cries were rated more "urgent" than fullterm cries, and elicited in mothers caregiving responses considered "tender and caring." Mothers responded to the onset of high-complications preterm cries with marked cardiac acceleration, whereas nonmothers responded with a slow rise. The differences on both caregiving and heart rate responses were interpreted to reflect a special sensitivity in mothers to preterm cries.

The second experiment introduced several methodological

modifications: 1) a larger sample of mothers of fullterm infants; 2) exclusion of coos; 3) exclusion of blood pressure; and 4) introduction of digitized heart rate data logging procedure. In addition, on a second trial, it examined the modifiability of cardiac changes by providing subjects with labels (correct, incorrect, or no label) for the cries, according to the infants' risk, and gestation status. The cardiac response to the high-risk preterm cries seen in Experiment 1 was not replicated. Trends revealed that for mothers, preterm cries, and high-risk cries, elicited cardiac acceleration, as well as caregiving responses considered "immediately effective in terminating the crying" and "tender and caring." Nonmothers responded to all cries with marked cardiac acceleration. Cardiac acceleration was elicited in nonmothers by the high-risk preterm cries labeled healthy fullterms, while mothers evidenced cardiac deceleration to these cries.

These experiments show differences between preterm and fullterm cries, as well as between low- and high-risk cries on caregiving and heart rate responses. Mothers were found to be particularly sensitive to these differences. It was suggested that the translation of the caregiving intentions into overt responses might shed further light on maternal behavior. Cardiac acceleration was interpreted as a nonspecific spontaneous physiological response to cries which is modifiable by cognitions. Finally, it was suggested that the observed effects of labeling upon heart rate could have implication for modifying potentially maladaptive cardiac hyperreactivity to infant crying.

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TABLE OF CONTENTS

List of Tables

List of Figures

The perceived characteristics of infant cries and their impact on adults are of interest because of their potential implications upon adult-infant interactions. Specifically, research on maternal response to infant crying has been instigated by theories of attachment (Ainsworth, 1969; 1972; Bowlby, 1969) which stress the potency of infant cues in moderating caregiver behavior. Research emerging on this topic has focused on two principal issues: (1) the characteristics of infant signals that affect the caregiver, and (2) the search for objective and sensitive indices of caregiver responsivity.

Studies investigating the impact of infant cries have employed diverse methodologies. A variety of self report measures were first used to evaluate adults' responsiveness. More recently, however, in combination with self reports, maternal physiological response is increasingly being investigated. In particular, in response to infant cries and smiles, researchers have monitored heart rate reactivity on the assumption that this may constitute a sensitive measure of maternal autonomic and behavioral states. The rationale for focusing on heart rate stems from reports in the psychophysiological literature which indicate that the direction of cardiac change elicited by sensory stimulation can serve as an index of attentional processes (Graham & Clifton, 1966), or alternately, as an index of motivational dispositions (Obrist, 1976).

A relatively small body of literature has examined the role of cardiac reactivity to infant affective signals. First, it appears that maternal response to infant signals is influenced by diverse factors which are presently not well understood. For example, both relatedness of the listener to the infant and infant gestational status (preterm/fullterm) have been separately implicated as factors which may influence maternal response to cries. It is not clear, however, how these factors interact with, or are differentiated by, heart rate reactivity patterns. Second, the pattern of maternal cardiac response has not been readily interpretable according to current psychophysiological models (e.g., Graham & Clifton, 1966; Obrist, 1976). At present, therefore, it is difficult to evaluate the significance of heart rate reactivity to infant cries. Systematic empirical analysis of both subjective and cardiac response to infant cries seems warranted.

The present research, therefore, explored how certain factors concurrently influenced both subjective and physiological responses to infant cries. The main question concerned the extent to which maternal cardiac and subjective response to infant crying are meaningfully related. The rationale underlying the approach was the contention that maternal experience results in enhanced sensitivity to infant cry characteristics. Delineating simultaneously how this "sensitivity" is reflected in maternal heart rate and subjective response patterns seemed a promising route to pursue. Specifically, under varying experimental conditions, mothers' and nonmothers' subjective and psychophysiological responses to the cries of high- and low-risk preterm and fullterm infants were gathered, to explore whether orderly relationships between maternal subjective and physiological responses were evident.

The following sections outline the current state of the literature on maternal subjective and heart rate response to cries. First, the theoretical formulations addressing the adaptive purpose of infant signals (crying and smiling) that have provided the basis for most studies are presented. A second section examines what is known about the perception of cries with respect to self reports, with emphasis on what is known about maternal perception and response. The final section describes the physiological data, with emphasis on relationships between self report and cardiac data.

Theoretical Models of the Adaptive Purpose of Infant Signals (Crying and Smiling)

Bowlby (1969) and Lamb (1978) have argued that smiles serve as cues which encourage adults to interact and remain in close proximity with infants. Cries, on the other hand, elicit adult behavior aimed at alleviating the infant's distress.

One group of researchers (Frodi, Lamb, Leavitt, & Donovan, 1978a; Frodi, Lamb, Leavitt, Donovan, Neff, & Sherry, 1978b; Frodi, Lamb, & Wille, 1981) have argued that different motivational dispositions underlie the adult reactivity to infant vocalizations. Smiles, which elicit adult behavior aimed at maintaining the signal, may be perceived as pleasant. In contrast, cries, which result in adult behavior directed at terminating the vocalization, may be perceived as aversive. Essentially, in this paradigm, the cry functions chiefly as an aversive cue to the caregiver, who presumably responds to the infant's vocalization in a manner designed to terminate the noxious event. This type of response has been referred to by Murray (1979) as "egoistic motivation." For Frodi and her colleagues, the focus of their research, therefore, has been on the aversive properties of cries, and in delineating the characteristic physiological pattern that they elicit.

Another group of researchers (Wiesenfeld & Malatesta, 1982) have argued that a caregiver's response to infant cries involves a much more complex cognitive-affective component. They believe that the comparison of the physiological response to cries with the response to simpler aversive cues is inappropriate. This argument has as its basis the specificity of the concept of attachment, which has been defined by Ainsworth (1972) as an affective bond between one individual and another. Consistent with the concept of attachment, Wiesenfeld and Malatesta (1982) have pointed out that one possibility is that a caregiver's response to cries reflects what Murray (1979) calls "altruistic motivaton" -- a response triggered through an empathic sharing of the infant's distress. Further, Wiesenfeld and Malatesta (1982) have concluded that if the concept of attachment possesses any ecological validity, a specific attachment-related component should be evident in a caregiver's characteristic physiological response to cries.

Unlike the model outlined by Frodi and her colleagues which makes no implicit or explicit assumptions about the role of a relatedness factor, Wiesenfeld and Malatesta's model does make an explicit assumption about relatedness. This latter model proposes that the pattern of the caregiver's physiological response to a familiar cry should be distinct from the pattern to an unfamiliar cry. Consequently, while the Wiesenfeld group has focused on the caregivers' physiological response to both familiar and unfamiliar cries, the Frodi group has investigated only unfamiliar cries.

Moreover, the two groups of researchers have employed different psychophysiological models to interpret their findings. Because of their emphasis on the aversive characteristics of cries, Frodi and her colleagues have relied on Graham and Clifton's (1966) Defensive-Orienting Response model of cardiac functioning. In Graham and Clifton's model, heart rate acceleration is conceptualized as reflecting a defensive response or rejection of the external environment, while deceleration is indicative of an orienting response or intake of the external environment. Thus, in Graham and Clifton's model an acceleratory response to cries is indicative of a defensive response or rejection of aversive stimulation, while a response characterized by cardiac deceleration reflects orientation or attention.

Wiesenfeld and Malatesta (1982), on the other hand, have found the Defensive-Orienting model problematic, and have opted for the Cardiac-Somatic Coupling model proposed by Obrist (1976). Obrist has essentially conceptualized cardiac changes along an activity-passivity dimension. He postulates that cardiac changes are directly related to energy required by the musculature to ready the organism for coping somatically with the arousing event. Consequently, in Obrist's model cardiac acceleration reflects covert behavioral patterns of active coping or a readiness for exercise, which ostensibly can be elicited by an empathic sharing of the infant's distress. Deceleration would reflect a passive stance, or a readiness for a less taxing metabolic state.

Self Report Findings: Subjective Perceptions and Responses of Caregivers to Cries

Because psychophysiological measures are by themselves difficult to interpret, researchers have often concurrently monitored self reports. Thus, before examining the data on the cardiac effects of infant cries in the context of the two physiological models, the impact of infant crying upon subjective response is first examined. For instance, evidence of subjective "rejection" or "empathic sharing" would provide a good basis for evaluating the usefulness of the two heart rate models in interpreting the cardiac response to cries. However, there are no published studies that have investigated caregiver empathy, and its relationship to maternal sensitivity to infant cries. Consequently, most of the data which will be examined are from studies that stress the aversiveness of cries. Similarly, since there are only two reports in the literature on caregivers' perception of familiar versus unfamiliar cries, this dictates that the discussion focus primarily upon the caregivers' perception of unfamiliar cries.

In reviewing the literature on parents' and nonparents' ratings of cries of particular subgroups of infants, several consistent findings have emerged. Firstly, unfamiliar fullterm cries are perceived as unpleasant, distressing, and irritating. Secondly, cries of certain infant populations appear to be reliably differentiated by adults, with certain cries being perceived as more aversive than others. Thirdly, parental experience, and more specifically maternal experience appears to influence the perception of cries.

Zeskind and Lester (1978) in the first of a series of studies, investigated the perceptions of the pain cries of clinically healthy fullterm infants with either a low or high number of nonoptimal conditions according to Prechtl's (1968) Scale of maternal and parturitional obstetric complications. Groups of parents (parity not reported), and inexperienced nonparents (no experience with infants or young children) listened to 10-s cries of eight low-complications and eight high-complications fullterm infants on a single tape arranged in two random orders. Each cry segment was rated on four different scales each time it was presented. The rating scales were generated from descriptions in the psychological and pediatric literature on cry sounds.

The Zeskind and Lester (1978) study yielded several findings: (1) the cries of the high-complications infants differed from cries of the low-complications infants on a number of acoustic parameters; (2) the high-complications infants' cries were perceived as more aversive, grating, sick, urgent, distressing, piercing, discomforting and more arousing than low-complications cries; (3) parents rated all cries as less aversive than nonparents; and (4) factor analysis revealed that although the cries of both complications groups were perceived as "unpleasant," high-complications infants' cries were also perceived as "sick" and "urgent." These findings were interpreted as evidence that the high-pitched quality of cries characteristic of infants with a range of medical conditions may possess evolutionary adaptive qualities. At the same time, it was also argued that in a nonsupportive environment, cries of high-risk infants that are perceived as especially aversive could have negative consequences on the development of the infant-caregiver relationship. In extreme cases aversive cries might even lead to physical abuse of the child.

In an extension of Zeskind and Lester (1978), Zeskind (1980) investigated whether the perceptual dimensions of the cries of the "at-risk" infant signal different needs. Parents of mixed parity (1 to 3 children, none of whom were less than eight months of age) and nonparents listened to 10-s cry segments. They were asked to select from six possible caregiving choices the response that seemed most appropriate. Choices included (a) feed, (b) cuddle, (c) pick-up, (d) clean, (e) give a pacifier, and (f) wait and see. These caregiving choices were subsequently ranked by subjects on two dimensions: (1) "how tender and caring the response is," and (2) "how immediately effective the response is at terminating the crying."

Zeskind (1980) reported that cries of the high-risk infants elicited from parents' responses that were more "tender and caring" and more "immediately effective at terminating the crying" than the cries from low-risk infants. In addition, responses from parents to the high-risk cries were more consistent than to low-risk infant cries. Both of these effects were evident only in parents. Moreover, when the caregiving choices were categorized according to their functional significance it was found that 21 of 30 parents gave contact-comfort type responses to the high-risk cries and none gave undirected responses.

These results, like the results of the first study, were interpreted to support a functional role for the cries of the "at risk" infant. Further, Zeskind (1980) speculated that perhaps experience with infants was a critical factor in translating different perceptions into decisive actions. It should be noted, however, that parents and nonparents in the Zeskind study differed not only in caregiving experience, but also in age. It is, therefore, very difficult to define the factors that may have affected the differential responsivity of parents and nonparents.

In yet another study, Zeskind (1983) investigated the responses of Anglo-American, Black-American, and Cuban-American mothers. Both primiparous and multiparous mothers listened to high- and low-complications cries during the hospital lying-in period after giving birth. Four of the eight Zeskind and Lester (1978) scales were employed in this study in conjunction with the Zeskind (1980) six caregiving choices, but these choices were now rated on a 7-point scale in terms of how appropriate each response would be for the cry heard. Zeskind (1983) found that, regardless of parity, the women of all three cultures rated the high-risk cries as more urgent, sick, distressing, and more arousing than the cries of low-risk infants. Ratings of the high-risk cries, however, were found to be tempered (perceived as more or less aversive) depending on the number of children the women had, as well as their cultural background. Finally, although no parity effects were found for the caregiving choices, high-risk cries elicited from all three cultural groups higher ratings on "pick-up" and "feed," and lower ratings on "give a pacifier" than the low-risk cries.

The findings of the Zeskind (1983) study revealed that mothers are particularly sensitive to the cry of the high-risk infant both in terms of perceptions and caregiving responses. It is difficult, however, to evaluate the specific effect of maternal experience on the perceived characteristics of cries because the inexperienced and experienced caregivers were studied under unique circumstances (2 days after the birth of a child).

In the last of this series of studies, Zeskind and Huntington (1984) investigated the effect of within- and between-group designs on the response to the low- and high-risk cries. Nonparents listened to either low- or high-risk cries in a first phase, both low- and high-risk cries in a second phase, and in a third phase, the same cries heard in the first phase. The Zeskind and Huntington (1984) data were not entirely consistent with the previous findings because during the between-group phase (i.e., one cry type presented) only two of the four scale items which were employed differentiated the cries. While two important scale items, "aversive" and "urgent" did differentiate the cries, the "sick" and "distressing" scale items did not. The authors have subsequently stressed "context" as a critical factor in evaluating cry perception data. At the same time, they also speculated that perhaps the failure to find differences on certain scales may be attributed to the nonparents' lack of a "comparison set." This comparison set is presumably created through experience with one's own infant. Parents, but not nonparents, would have this comparison set.

In contrast to pain cries, the basic (spontaneous) cries of unfamiliar fullterm infants categorized by mothers as "difficult," "average" and "easy" have also been investigated. These cries, like the pain cries of the low- and high-risk infants, appear to be reliably differentiated on the basis of acoustic parameters, as well as by listener ratings.

Lounsbury and Bates (1982) investigated unrelated primiparous mothers' (infant's age 4-6 months) ratings of cries of "difficult," "average" and "easy" infants. Ratings of the cries were made on three different scales: 1) a behavioral intervention scale categorized on three global levels of (a) social stimulation, (b) caretaking, and (c) avoidance; 2) an emotional reaction scale reduced to the categories (a) anger plus irritation, (b) desire to mother plus speed of response to infant, (c) sadness, (d) perception of infant as "spoiled"; and 3) a perceived cause of crying checklist summarized in the categories (a) hunger, (b) minor physical discomfort other than hunger, (c) major physical discomfort, (d) psychological or emotional discomfort.

Lounsbury and Bates (1982) reported that cries of the "difficult" and "average" infants elicited higher "irritation" and "spoiled sounding" ratings from the primiparous mothers than did the cries of "easy" infants. In addition, when the data were examined with respect to the amount of prior experience which mothers had with infants, experience emerged as a major factor which affected the mothers' ratings. Primiparous mothers categorized as highly experienced because of the amount of time spent with their own and others' infants rated the "difficult" cries as more "spoiled sounding" than the inexperienced mothers, but tended to rate the "average" and "easy" cries as less "spoiled sounding" than inexperienced mothers. Experienced mothers also gave lower "irritation" ratings than inexperienced mothers to the "average" and "difficult" cries.

In a subsequent study, Boukydis and Burgess (1982) using Lounsbury and Bates' (1982) stimuli investigated the responses of nonparents, primiparous parents (own infant 3- to 5-months old), and multiparous parents (one infant 3- to 5-months old). Ratings on a 4-section response sheet were gathered. Section one of the response sheet consisted of ratings on four items adopted from Lounsbury and Bates' (1982) study: anger/irritation; sadness; spoiled; and care for. Section two were the Zeskind and Lester (1978) scales with an additional scale -- manipulative/notmanipulative added. The third section consisted of ratings with respect to similarity of the cries to the subjects' own infants (parents only). Finally, section four pertained to the probable cause of the infants' crying (e.g., wet or dirty, fatigue, etc.).

As in the Lounsbury and Bates (1982) study, cries were again differentiated with the "difficult" cries receiving the highest "irritation" and "spoiled" ratings, and were attributed more frequently to frustration as opposed to physical discomfort. In addition, "difficult" cries were perceived as most grating, arousing, piercing, and aversive, and elicited the lowest "care for" ratings. Parental and parity effects, as well as specific effects of maternal experience were also found. Multiparous parents and primiparous parents both differed from nonparents with respect to probable cause of the infants' cries, with nonparents choosing "too hot" or "too cold" and "fright" more frequently than both parent groups. Multiparous parents were found to rate all cries as less piercing than both nonparents and primiparous parents. Finally, both primiparous and multiparous mothers gave as their reaction to the cries more "care for" responses than nonmothers.

Although much is known about the perception of fullterm cries, very little is known about the perception of preterm cries. On the basis of the existing evidence, however, it appears that cries of preterm and fullterm infants are not reliably differentiated by adults.

Frodi et al. (1978a) employed a labeling procedure to investigate how caregivers perceive the preterm infant's affective signals. Parents of 9-month-old infants watched a 6-min televised image of an unfamiliar fullterm infant. They saw the infant either crying or smiling, with the infant labeled as "normal," "difficult," or "premature" to equal proportions of the sample. Subjective responses were assessed by a mood adjective checklist. Parents were more sympathetic to the crying infant labeled normal than to the same infant when labeled as either difficult or premature. Thus, although not an overwhelming effect, it does appear that a somewhat negative response to the atypical infant was effected on the basis of the cognitive set provided through the brief experimental manipulation of labeling.

Frodi et al. (1978b) investigated the effect of the facial appearance and cries (type not reported) of preterm and fullterm infants. Parents of a 5-month-old infant saw either a normal unfamiliar fullterm newborn or an unfamiliar preterm infant who was in turn quiescent, crying, and quiescent. Sound tracks were dubbed so that each infant emitted the cry of a fullterm infant to one half of the sample, and the cry of a preterm infant to the other half of the sample. Analysis of the mood adjective checklist in the Frodi et al.'s (1978b) study revealed that preterm cries were perceived as more aversive and irritating than fullterm cries.

In the last of these studies, Frodi et al. (1981) investigated the effect of the pain cries, and appearance of preterm and fullterm infants on mothers of preterm and mothers of fullterm infants. Mothers of mixed parity with either a young preterm or a young fullterm infant (postnatal age: 7 months) viewed a 6-min. televised image of a preterm infant followed by the image of a fullterm infant (or vice versa) in the sequences, quiescent, crying, quiescent. Results of this study were inconsistent with previous findings. Analysis of the mood adjective checklist data revealed the preterm and fullterm cries elicited similar subjective responses. These conflicting findings may reflect the fact that only one preterm and one fullterm cry were presented.

Only one other study of preterm infants' cries has been reported. Friedman, Zahn-Waxler, and Radke-Yarrow (1982) employed four of the Zeskind and Lester (1978) scales, with one additional scale reflecting the degree of maturity of the infant, in an investigation of mothers' (parity not reported) responses to the infants' pain cries. The cries, recorded during a neurological examination, were gathered from 4 moderate-risk preterm infants, 4 low-risk preterm infants, and 4 healthy fullterm infants. Risk status was defined globally by birthweight, Hobel Infant Risk score, and lengths of intensive care and hospital stay.

Friedman et al. (1982) reported that preterm cries were not uniformly rated as more aversive than cries of fullterm infants. Although moderate-risk preterm cries were consistently rated more negatively than either fullterm or low-risk preterm cries, some low-risk preterm cries were consistently rated less negatively than fullterm cries.

The fact that cries of moderate-risk preterm infants were consistently rated most negatively is consistent with the findings of Zeskind and his colleagues (Zeskind & Lester, 1978; Zeskind, 1983; and Zeskind & Huntington,

1984) showing that in healthy fullterm infants greater aversiveness of the cry is associated with a higher level of medical risk. Data from another source, however, conflict with those of Friedman et al. (1982).

In a previous unpublished study, Bryan, Taylor and Seraganian (1984) investigated the effect of maturation of the preterm infant's cry on primiparous mothers' (infants' mean age 12.4 months) and nonmothers' responses. The spontaneous cries of six moderate-risk preterm infants recorded at 38 and 44 weeks postconceptional age, along with the cries of six fullterm infants, and six examples of control coos and babbles were employed. In mothers' and nonmothers' ratings on the eight Zeskind and Lester scales there was no indication that preterm cries were perceived as more aversive than the cries of fullterm newborn infants.

One possible explanation of the discrepant results of Friedman et al. (1982) and Bryan et al. (1984) is that different complications status were represented in the moderate-risk samples of each study. In addition, the two studies used different global criteria of risk in the preterm samples, and neither controlled for level of risk in the fullterm sample except for selecting healthy fullterm infants. Finally, Bryan et al. investigated the basic cry, in contrast to Friedman et al., who investigated the pain cry.

Regarding caregivers' perception of familiar versus unfamiliar cries, there do not appear to be marked differences in the perceived unpleasantness of these cries. Wiesenfeld and Klorman (1978) investigated mothers' responses to silent videotaped images of their own infant's smiling and crying, an unfamiliar infant's smiling and crying, and neutral landscape scenes. Subjective responses consisted of ratings of the stimuli in terms of their unpleasantness, as well as the amount of subjective tension they elicited. Wiesenfeld and Klorman (1978) reported that the image of the familiar infant's crying induced more feelings of tension than the image of unfamiliar infants, but that there were no differences in caregivers' perception of the unpleasantness of the familiar and unfamiliar crying infant.

In another study, Wiesenfeld et al. (1981) investigated mothers' and fathers' responses to the following: 1) the sound of pain and anger cries of their own infant; 2) an unfamiliar infant's pain and anger cries; and 3) two tones. Like the Wiesenfeld and Klorman (1978) study, the stimuli were rated in terms of their unpleasantness and the amount of tension they elicited. In addition, caregivers rated the stimuli on their novelty or unusualness, and were also asked to identify whether the cry was that of their own infant or the unfamiliar infant, as well as to identify the type of cry (pain, anger, or other).

Wiesenfeld et al. (1981) essentially found few differences in caregivers' perception of the unpleasantness of the pain and anger cries of their own versus the unfamiliar infant. This finding emerged despite the fact that the caregivers, in particular mothers, were quite adept at recognizing their own infant's cries, as well as differentiating among their infant's cry types. The pain cries of both infants were perceived as most unpleasant, and elicited similar novelty ratings. The pain cry of the familiar infant, however, elicited more feelings of tension in mothers than the pain cry of the unfamiliar infant.

In summarizing the findings on self reports, relatedness of the listener to the infant does not appear to be a critical factor influencing caregivers' subjective perceptions of the unpleasantness of infant cries. With regard to unfamiliar cries, two factors appear critical: the specific characteristics of the cry, and whether or not the listener is experienced with infants. Although the impact of preterm cries relative to fullterm cries remains to be clarified, healthy high- and low-risk fullterm cries, as well as cries of fullterm infants of different temperaments have been consistently differentiated with cries of the high-risk and the "difficult" groups being reliably perceived as more aversive. Moreover, in their work, Zeskind and his colleagues have shown that parents differ from nonparents in their perception of cries, and in their ability to translate different perceptions into decisive actions, and that parity or the number of children women have had influences the perception of cries. Other researchers (e.g., Boukydis & Burgess, 1982) have also shown an effect of parity as well as a specific effect of maternal experience.

This effect of maternal experience on the response to infants and infant crying has been shown in several other studies. Wasz-Hockert, Partanen, Vuorenkoski, Michelsson, and Valanne (1964) reported that females experienced with infants, regardless of whether the experience was obtained through parenting or as obstetrical nurses, were more accurate in differentiating among cry types than were women who lacked such experience. Sagi (1981) in a study of mothers' and nonmothers' ability to identify cry types also reported that maternal experience was associated with a special sensitivity to the underlying cause of infant's cries. Finally, Feldman and Nash (1978) reported that mothers, unlike nonmothers, were more responsive to infants.

Physiological Data: Relationships Between Self Report and Cardiac Data Examined Within the Context of the Two Physiological Models of Cardiac Functioning

Given that self reports have indicated that parents, and in particular mothers, evidence a special sensitivity to infants' cries, the question remains as to whether this sensitivity is reflected psychophysiologically. Furthermore, if psychophysiological changes are seen, are they interpretable within the two models outlined earlier? The latter issue will be addressed first.

Although several studies have reported on what appears, according to the Graham and Clifton (1966) model, to be a defensive response to cries, data from other studies call this interpretation into question. Frodi and Lamb (1978) first reported evidence of the defensive response. Psychophysiological, behavioral, and subjective reactions were recorded. During a videotape session, young children and adolescents viewed an unfamiliar infant while quiescent, crying, quiescent, or quiescent, smiling, quiescent. Subjects who viewed the crying infant evidenced increased heart rate, and reported feeling less happy, more distressed and more irritated than subjects who viewed the smiling infant. Subjects who viewed the smiling infant responded with cardiac deceleration. Because smiling was perceived as pleasant, and elicited cardiac deceleration, the acceleration elicited by cries, in combination with the subjective reports of unpleasantness, was interpreted as evidence of a defensive response.

This "defensive" response to cries has since been replicated in two additional studies which investigated adult subjects. Frodi and Lamb (1980) in a study of child abusers' and nonabusers' responses to infant smiles and cries, reported that a similar heart rate acceleration was evidenced in normal mothers at the onset of the cry of an unfamiliar fullterm infant, while the onset of a smile elicited cardiac deceleration. These heart rate patterns, as in the previous study, were again accompanied by subjective reports indicating more feelings of annoyance, distress, disturbance, unhappiness and sympathy at the crying infant than at the smiling infant. Finally, Frodi et al. (1981) reported that along with subjective reports of irritation and aversion, cardiac acceleration was again the immediate response evidenced by mothers at the onset of unfamiliar cries.

In contrast, in two studies a dissociation between affective ratings and what appeared to be a cardiac defensive response was found. When mothers listened to unfamiliar infant coos and cries (Bryan et al., 1984), and when mothers viewed silent videotaped images of their own and an unfamiliar infant's smiling and crying (Wiesenfeld & Klorman, 1978) these stimuli were differentiated in terms of affective ratings and self reports of arousal. In the Bryan et al. (1984) study, however, cardiac acceleration occurred to both unfamiliar coos and cries, while in the Wiesenfeld and Klorman (1978) study, cardiac acceleration occurred to both familiar smiles and cries.

This dissociation is not easily reconciled with Graham and Clifton's Defensive-Orienting Response model.

The cardiac acceleration seen to coos and smiles cannot be attributed to feelings of aversion because they were rated as pleasant. Obrist's model of Active-Coping/Passive-Coping appears to accommodate these findings with less difficulty. In applying this model, Wiesenfeld and Malatesta (1982) have suggested that a mother's acceleratory cardiac pattern elicited by her own infant's affective states reflects a special attachment-related response, or covert behavioral patterns of active coping, which are triggered by a complex process of empathic sharing between a mother and her infant. No direct explanation is offered for the acceleration seen to smiles. However, presumably with empathic sharing and active coping, where, in the latter, according to Obrist (1976) the cardiovascular system is readied for exercise (in the case of smiles the action might be play), there is less reason to predict that a mother would necessarily respond differentially to her infant's smiling and crying.

On the other hand, Wiesenfeld and Malatesta's suggestion that cardiac acceleration reflects a special attachment-related response is problematic because cardiac acceleration has been shown to be elicited by both familiar as well as unfamiliar cries.

The cardiac acceleration found in the Wisenfeld and Klorman (1978) study was indeed elicited in mothers only when they viewed their own infant's crying and smiling.

Both the unfamiliar infant's signals elicited cardiac deceleration. Similarly, Donovan, Leavitt, and Balling (1978) in a study where mothers also viewed silent videotape images, but of unfamiliar infants smiling and crying, found that the response to the crying images was predominantly cardiac deceleration. In the more recent Wiesenfeld et al. 1981 study which investigated the impact of pain and anger cries of "own" versus an "unfamiliar" infant's pain and anger cries, mothers were again found to respond to their infant's cries with cardiac acceleration, while the cries of the unfamiliar infant elicited a deceleratory reaction.

Notwithstanding, the work by Frodi and her colleagues (Frodi & Lamb, 1980; Frodi et al., 1978b; 1981), as well as the work of Bryan et al. (1984), have shown that unfamiliar cries do elicit a similar cardiac acceleratory pattern in mothers. A direct comparison of the findings of these latter studies to the findings of Wiesenfeld and Klorman (1978), and Wiesenfeld et al. (1981), cannot be made, however, since familiar cries were not included in either the Frodi or the Bryan et al. studies.

Whether psychophysiological patterns provide support for the hypothesis that maternal experience results in a heightened sensitivity to infant cry characteristics is not clear. Although Frodi et al. (1978b) reported that the cry of the preterm infant elicited in mothers greater cardiac acceleration, in addition to greater increases in skin conductance levels and blood pressure, than the cry of a fullterm infant, these effects have subsequently not been replicated (Frodi et al., 1981). One specific type of maternal experience was shown in the Frodi et al. 1981 study, however, because mothers of premature infants responded with more marked physiological arousal than did mothers of fullterm infants to the cry of both the preterm and the fullterm infant.

Similarly, in the Bryan et al. (1984) study mothers were not found to be particularly sensitive to preterm and fullterm cries because no differences in cardiac reactivity patterns, skin conductance or blood pressure changes were elicited as a function of these cries. However, an effect of maternal experience was found. Although nonmothers, like mothers, evidenced a pattern of cardiac acceleration during the first presentation of the vocalization types, only mothers continued to show this acceleratory pattern when the response over all vocalizations was averaged. The mothers' response was interpreted to reflect a general heightened sensitivity to infant signals.

Bleichfield and Moley (1984) in a study of women in different phases of the maternal cycle also reported evidence of a general heightened sensitivity to an infant cry as a function of maternal experience. They reported that unlike the inexperienced groups who decreased heart rate after the short initial cry burst, and showed no significant acceleration during the second and longer cry burst, the experienced groups showed marked acceleration during the second longer burst. It is difficult to interpret these data, however, because subsumed under the experienced groups were pregnant mothers, multiparous mothers who had recently given birth, and mothers who had not given birth recently. Maternal state and experience may present a serious confound. Moreover, women in the experienced groups were consistently older than the women in the inexperienced groups.

While the cardiac data suggest that maternal experience results in a general heightened sensitivity, there is less evidence that mothers possess a special sensitivity to infant cry characteristics. Regarding the latter issue the data are inclusive, however, because of the small sample of cries used in both the Frodi et al. (1978b, 1981) studies, and because of the criteria used for selecting the moderate risk preterm cries in the Bryan et al. (1984) study.

In summary, three main problems are evident from the cardiac data. First, in contrast to the findings on caregivers' subjective perceptions of cries, where "relatedness" played no significant role, "relatedness" appears to be one factor that influences the direction of change in mothers' heart rate response patterns. Cardiac acceleration has also been shown in the absence of the relatedness factor. This begs the question of precisely what is the significance of cardiac acceleration? For example, is the acceleration seen within and without the relatedness context reflecting a similar process?

Second, the physiological models proposed by Graham and Clifton, and Obrist, have not been particularly helpful in explaining the significance of maternal cardiac response, since both models present with their own unique problems. It is even questionable whether these models are appropriate in the context of infant affective stimuli. One thing that seems clear, however, is that infant cries are highly complex emotionally loaded stimuli. Consequently, in accord with Wiesenfeld and Malatesta (1982), as well as workers outside the field of research on infant affective stimuli (e.g., Hare, 1973), any interpretation of the response to this category of stimuli must account for the cognitive and affective factors that may be operating on the part of the listener.

Third, like the self report data, the cardiac data, as well as data from other physiological indices have yielded conflicting reports concerning maternal sensitivity to preterm cries relative to fullterm cries. Consequently, this issue remains to be clarified. The present research was instigated, therefore, by conflicting reports in the literature concerning (a) the impact of preterm cries on caregivers' subjective and physiological responses;

(b) the characteristic physiological response patterns elicited in caregivers by an unfamiliar infant's cries; and (c) the significance and modifiability of the psychophysiological response patterns elicited by infant cries. Two separate studies were conducted to address these issues. Study 1 was primarily concerned with the first two issues while Study 2 employed more rigorous methodology in addressing the latter issue.

Experiment 1

The aversive properties of preterm infants' cries may increase the risk for child abuse (Parks & Collmer, 1975). It seems important, then, that caregivers' perception of these cries be systematically studied. Moreover, if cardiac reactivity to preterm cries contribute to behavioral responses, the concurrent monitoring of self reports and psychophysiological indices seems called for.

The work of Friedman et al. (1982) suggests that a certain level of medical risk must be associated with the preterm infant in order for its cry to be perceived as especially aversive. There are no studies, however, that have systematically investigated the relationship between medical risk and perceived aversiveness of preterm cries. The link between neonatal history of medical risk and caregivers' perceived aversiveness of cries, has already been established in several studies for fullterm infants. Lacking, however, are studies that examine reactivity to high- and low-risk fullterm cries in a context where both psychophysiological and self report measures are taken.

Consequently, a systematic examination of the relation between medical risk and the aversiveness of preterm and fullterm cries, indexed by concurrent physiological and subjective responses is warranted. It is expected that this may provide a more comprehensive understanding of caregivers' response to cries. The first purpose of the following experiment, therefore, was to analyse, in a systematic way, the self reports and psychophysiological reactivity elicited to cries of unfamiliar high- and low-risk preterm and fullterm infants.

Specifically, one goal of the study was to determine whether high-risk preterm cries are perceived as more aversive than all fullterm cries, or whether the aversive quality of high-risk preterm cries is only evident when they are compared to cries of low-risk fullterm newborns. To achieve this goal, the cries of 4 3-day-old high-complications preterm, 4 3-day-old low-complications preterm, 4 3-day-old high-complications fullterm, and 4 3-day-old low-complications fullterm infants were investigated. The present study employed spontaneous cries, since it was felt that these cries were most representative of the cries caregivers are frequently confronted with. Subjective perceptions of the cries were assessed by using the Zeskind and Lester rating scales. In addition, the Zeskind Caregiving/Choices were also employed since it was felt that these would provide information about subjects' behavioral intentions, at least in a covert way.

A second purpose of the study was to explore psychophysiological reactivity to unfamiliar cries, and determine whether the psychophysiological responses to preterm and fullterm cries differed. It was reasoned that several findings might shed some light on the role of psychophysiological processes in adult behaviors. For example, if the cardiac pattern was different for preterm and fullterm infants, it would provide information about the sensitivity of heart rate as an index of maternal response. A relationship between the subjective assessment of aversion, covert behavioral intentions (particularly the intention to terminate the cry) and heart rate would also help to explain, in part, what cardiac acceleration elicited by cries might reflect. Although this relationship on the basis of past research has been elusive, it is conceivable that when stimuli are selected for their unique characteristics, a more clearcut relationship among measures might emerge. Consequently, in order to clarify the interpretation of the psychophysiological response pattern elicited by cries, infant coos were included as pleasant infant vocalizations.

In addition to heart rate, blood pressure was also monitored, since findings on this measure have been shown to converge with heart rate findings (Bryan et al., 1984; Frodi & Lamb, 1978; 1980; Frodi et al., 1978a; 1978b; 1981). As an index of general arousal, subjects were asked to indicate their level of arousal on a 7-point illuminated scale. This scale has previously been shown to be sensitive to psychosocial stress (Sinyor, Schwartz, Peronnet, Brisson, & Seraganian, 1982), and was also shown to be sensitive in differentiating infant affective stimuli in the Bryan et al. (1984) study. Finally, primiparous mothers and women without maternal experience were compared since a third purpose of the study was to clarify the effect of caregiving experience on maternal response to preterm cries.

It was hypothesized that infant coos and babbles would be perceived as pleasant stimuli, while cries would be perceived as unpleasant stimuli. Thus, cries would be rated less favourably than coos on the Zeskind and Lester scales. In addition, differences were expected between the arousal levels elicited by coos and cries, and differences were also expected to emerge on the physiological measures. Specifically, it was predicted that cries would increase arousal levels more than coos, and would elicit greater increases in blood pressure and heart rate. It was also predicted that the high-risk preterm cries would be perceived as more aversive, and elicit different caregiving responses, than both the low-risk preterm and low-risk fullterm cries. Thus, the high-risk preterm cries would be rated more negatively on the Zeskind and Lester scales, and elicit on the Zeskind Caregiving Choices, responses that were considered to be "more immediately effective in terminating the crying" than the cries of either low-risk preterm or low-risk fullterm infants; no prediction was made on the "tender and caring" dimension. In addition, high-risk preterm cries were expected to elicit greater increases in arousal level, blood pressure, and heart rate than the cries of either low-risk preterm or low-risk fullterm cries. It was predicted that these effects would be stronger in mothers than nonmothers. Finally, no hypotheses were formulated about the effects of the high-risk preterm cries in contrast to the high-risk fullterm cries, as well as about the effects of the low-risk preterm cries in contrast to the low-risk fullterm cries.

Method

Subjects

Subjects were groups of age-matched, middle-class, English speaking (19 Caucasian and 4 black) women. They were solicited from students, as well as acquaintances of students of Concordia University. One group consisted of 11 primiparous mothers (mothers' age: $\overline{X}$ = 27.4 years, range = 18 - 36 years; infants' age: $\overline{X}$ = 13.4 months, range = 3 - 21 months). The second group consisted of 12 nonmothers (age: $\overline{X}$ = 25.8 years, range = 18 - 40 years) with no prior caretaking experience of an infant under 2 years for as long as two weeks. All subjects were offered $8 as remuneration.

Apparatus

The experimental room consisted of a temperature and humidity-controlled electrically shielded enclosure (305 cm x 335 cm, Spectrashield). A 4-channel Beckman 511A Dynograph recorder (polygraph) was employed to monitor heart rate and subjective arousal level. Heart rate was recorded using Beckman Dyna/trace ECG electrodes filled with Beckman electrode electrolyte, with the signal processed through a Beckman (Type 9857) cardiotachometer coupler. The electrodes were applied to the subject's upper body, specifically the lower center of the back (reference position), immediately over the heart (left side of the chest near the sternum), and the right side at the height of the umbilicus. Subjective arousal level was indicated on a 7-point illuminated scale, comprised of a wooden panel (68 cm x 13 cm) with a series of seven miniature incandescent bulbs (No. 1819) spaced 7 cm apart (3 red lenses located on either side of a central white lens) mounted on the panel. Numbers above the lights read "-3," "-2," "-1," "0," "+1," "+2," "+3" with corresponding labels below the lights reading "very relaxed," "relaxed," "slightly relaxed," "now" (central reference point), "slightly aroused," "aroused" and "very aroused." The scale was mounted directly in front of the subject. A 4-cm diameter knob located under the right arm of the chair in which the subject was seated activated one of the corresponding series of these seven lights. The output of the dial was fed into one channel of the polygraph to provide a record of the dial setting. Digital blood pressure readings were obtained from a self-inflating Vita-Stat blood pressure monitor (Model No. 900-S). A Uher Report monitor (Model No. 4400) and a Uher Unidirectional microphone (Model No. 534) were used for the master recording of the infant cries and coos. A Sony Stereo tape recorder, Three Head Solid State TC-630 (Sony Corp., Model No. 153722) equipped with two sets of Sony stereo headphones was used for experimental presentation of the stimuli.

Stimulus Material and Design

Stimuli consisted of recordings of the spontaneous cries of four low-complications (low-risk) preterms (PL), four high-complications preterms (PH), four low-complications fullterms (FL), and four high-complications fullterms (FH). In addition, there were eight recordings of infant coos and babbles (coos). Recordings of the 16 infant cries were made at the St. Mary's Hospital preterm and newborn nurseries, Montreal, when the infants were three days old. All infants were undressed and placed on a scale for weighing approximately one hour prior to a scheduled feeding. This procedure was adopted because it is known to trigger spontaneous crying in young infants. The microphone was placed a standard six inches away from the infants, and each infant was given time to fuss and cry. Complications status was determined by counting the number of nonoptimal perinatal and prenatal risk factors experienced by the infants according to Prechtl's (1968) Scale of maternal and parturitional obstetric complications. Prechtl previously used lower scores of optimality as an index of the degree of risk or insult to the infant's central nervous system. More recently, other researchers (Parmelee, Kopp & Sigman, 1976; Zeskind & Lester, 1978) in studies of infants presumed to be at risk have also employed the Prechtl Scale. The precise criteria for assigning high- and low-complications status were adopted from the Zeskind and Lester (1978) study; low-complication status referred to infants with 2 or fewer nonoptimal conditions and high-complications to those with 5 or more nonoptimal conditions. Appendix A contains characteristics of the infants, as well as a list of obstetric complications found for the sample.

The mean number of complications for the four high-complications preterms ($\bar{X}$ GA 35.0 weeks) was 5.5, and for the four low-complications preterms ($\bar{X}$ GA 35.6 weeks) the mean number of complications was 1. The four high-complications fullterms ($\bar{X}$ GA 39.6 weeks) had a mean of 5.7 complications, while mean complications for the four low-complications fullterms ($\bar{X}$ GA 39.3 weeks) was .5. There were two males and two females in each complications group.

The eight recordings of coos were obtained from 6- to 12-month-old normal healthy infants, in the home, or while attending the follow-up clinic at the Jewish General

Hospital, Montreal. The microphone was held about 6 inches away from each infant. Sound level analysis indicated that the intensity of each vocalization (coos and cries) ranged from 60 to 80 db.

Four experimental tapes (Scotch 3M Audio Recording Tape) were used. Each tape consisted of six different 30-s vocalizations: one low-complications and one high-complications preterm cry, one low-complications and one high-complications fullterm cry, and two coos (one predesignated as a preterm control and the other predesignated as a fullterm control). The two preterm cries and the two fullterm cries occupied either the second and the third or the fifth and sixth segments of each tape. The first and fourth segments of each tape were always coos. Order of presentation of cry type, as well as complications status, was counterbalanced for each group of subjects.

Each tape began with a series of instructions followed by a practice trial consisting of two infants' cries. These two cries (1 30-s segment of a fullterm infant cry and another segment of a preterm cry) were not included in the experimental stimuli. Each vocalization was separated by a 3-min interstimulus interval, and a 5-min interval separated practice trials from the first segment of experimental stimuli.

Subjective Measures

Zeskind and Lester Scales (Z & L Scales). The eight

7-point Zeskind and Lester scales were presented on each page of an eight-page rating booklet. The scales are (1) urgent-not urgent; (2) pleasing-grating; (3) sick-healthy; (4) soothing-arousing; (5) piercing-not piercing; (6) comforting-discomforting; (7) aversive-nonaversive; and (8) nondistressing-distressing (Appendix B). The polarity of four scales were reversed before scoring. Hence for all scales the highest level of aversiveness was represented by 7 and the lowest by 1.

Zeskind Caregiving Choices. Located at the end of each page of the Zeskind and Lester rating booklet, were the six Zeskind Caregiving Choices: (1) feed, (2) cuddle, (3) pickup, (4) clean, (5) give a pacifier, and (6) wait and see. The six caregiving choices were also presented on a separate page for purposes of subjects ranking each choice from 1 to 6 on two dimensions: (a) "how tender and caring the response is," and (b) "how immediately effective the response is at terminating the crying" (Appendix C). Thus for scoring purposes two ordinal scales on two dimensions were created, with a score of 1 representing the highest rank and a score of 6 the lowest rank.

Subjective Arousal (SAL). The ratings taken from the 7-position dial ranging from "-3" ("very relaxed") to "+3" ("very aroused") were converted for scoring purposes to a 1 to 7 scale, with a score of 1 equivalent to -3 and a score of 7 to +3.

Psychophysiological Measures

Blood Pressure. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) readings obtained during the last minute of the three minute period of silence preceding each vocalization served as baselines. Baseline readings were compared to readings obtained during the vocalizations (stimulation scores), as well as to readings obtained immediately after the vocalizations (post stimulation scores).

Heart Rate. Heart rate in beats/minute was obtained by appropriate conversion of actual measurements of the interbeat intervals which were then averaged for each 1-s interval. Baseline scores were based only on the 10 prestimulus seconds preceding the first experimental stimulus for a comparison with the first 10-s of each of the six vocalization segments.

Procedure

Subjects were instructed not to engage in any strenuous exercise, coffee drinking, or smoking for a minimum of two hours prior to the experiment. Each subject was tested individually in a 40-min test session, and heard one of four experimental tapes. Upon arrival the subject was taken to the preparatory room where she was seated and encouraged to relax. The procedure was explained to her in terms of the various indices being measured, but care was taken to withhold the specific purpose of the study. Following preparation of the skin with alcohol, the electrodes were affixed to the appropriate areas. Finally, the subject was asked to fill out a brief questionnaire with respect to demographic information: maternal experience, age, and level of education achieved, etcetera (Appendix D). The subject was then shown into the experimental chamber where after being seated in an armchair facing the panel of lights, electrodes were connected to the polygraph for continuous heart rate readings, and the blood pressure cuff attached. Headphones were then placed on the subject, following which the subject experienced a 3-min period of silence where she was encouraged to sit quietly and to try to relax. This period was designed to facilitate the subject's adjustment to the testing chamber and to the various monitors, as well as to obtain some indication of the subject's normal resting blood pressure and heart rate. Following this period, stimuli were presented and all subsequent instructions were communicated to the subject over the headphones. Appendix E contains the instructions given to all subjects. In order to facilitate monitoring of the stimuli the experimenter was also equipped with a pair of headphones. The subject was instructed to indicate her arousal level before and after each vocalization by turning the dial below her right hand. Following the subject indicating her level of arousal, she was also instructed to rate each vocalization on the Zeskind and Lester scales during the first minute of the interstimulus interval. In addition, the subject was told verbally at the beginning of the session that in the case of cries, after rating each one, she should choose a caregiving response that seemed most appropriate for the cry. Clear instructions and a demonstration was given with respect to filling out the scales and indicating subjective arousal level. The practice trial consisting of two infant cries was then given, followed by a 5-min rest period during which the subject was again encouraged to try to relax. Figure 1 shows how the stimuli were presented, as well as the experimental protocol for one subject. Prior to presentation of the experimental sounds all instructions regarding the tasks were again repeated. Blood pressure readings were monitored 1 min prior to each vocalization after the subject had indicated her level of arousal, and at the beginning of each 30-s vocalization to obtain a reading during the vocalization. Post vocalization blood pressure readings were obtained immediately after the subject had again indicated her level of arousal and had rated the vocalization. The ranking of the caregiving choices was done by the subject at the end of the session after all vocalizations had been presented.

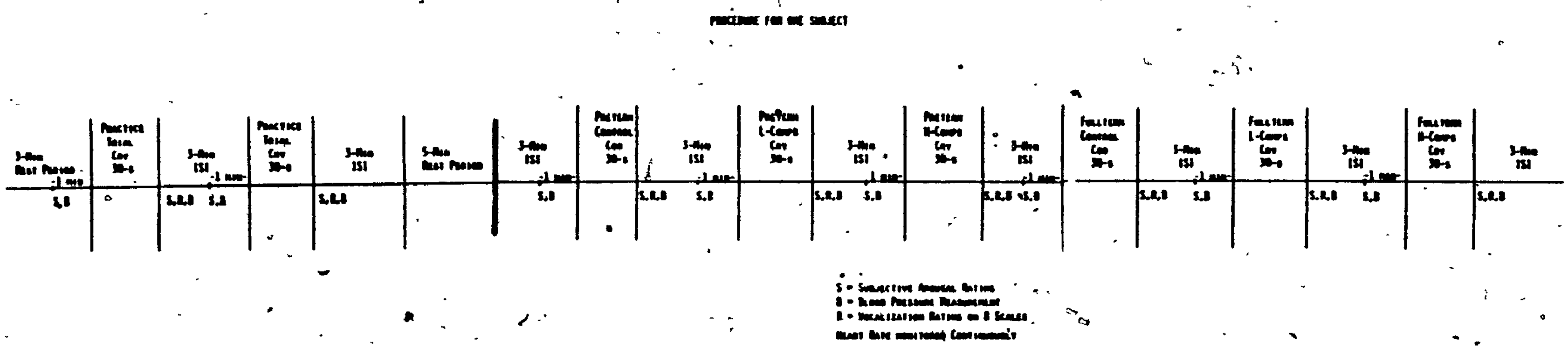


Figure 1. Experiment 1: Experimental protocol and presentation of stimuli for one subject.

Results

Subjective Measures

Vocalization Ratings. Mean ratings of each type of vocalization as a function of risk level are presented in Table 1. Ratings of the vocalizations on each of the Zeskind and Lester scales were subjected to separate analyses of variance (ANOVAS) with infant experience group (mothers/nonmothers) as a between-subjects factor, and vocalization type (preterm/fullterm), and risk level (no risk = coos/low-complications/high-complications) as within-subjects factors. The ANOVA source tables are presented in Appendix F. The analyses, along with subsequent Scheffé tests, indicated that cries were generally perceived negatively, while coos were perceived positively on all eight scales ($p < .01$). The two sets of control coos, however, elicited different degrees of positive ratings from mothers and nonmothers. The main effect of risk was significant at the .0001 level in each case: Urgent, $F(2,42) = 81.85$; Grating, $F(2,42) = 273.18$; Sick, $F(2,42) = 24.60$; Arousing, $F(2,42) = 188.18$; Piercing, $F(2,42) = 61.38$; Discomforting, $F(2,42) = 179.58$; Aversive, $F(2,42) = 106.40$; and Distressing, $F(2,42) = 120.89$. The main effect of risk on the "Grating" scale was qualified by a significant risk x group interaction, $F(2,42) = 4.72$, $p < .01$, a significant vocalization x risk interaction, $F(2,42) = 3.80$, $p < .03$, and a significant

Table 1

Means and Standard Deviations for Vocalization Ratings

Scale		Coos				Preterm Cries				Fullterm Cries			
		P Control		F Control		L Comp.		H Comp.		L Comp.		H Comp.	
		E[A]	I[B]	E[A]	I[B]	E[A]	I[B]	E[A]	I[B]	E[A]	I[B]	E[A]	I[B]
Urgent		1.2	1.2	1.3	2.0	5.2	5.2	5.2	5.4	4.6	5.0	5.2	4.2
	S.D.	.4	.4	.9	1.1	1.3	1.6	2.1	1.2	2.2	1.3	1.8	1.6
Grating		1.3	1.3	1.3	2.6	5.9	5.7	5.7	5.5	5.7	5.5	5.7	5.0
	S.D.	.5	.6	.6	1.6	.7	.9	1.0	.8	1.2	1.0	1.1	.9
Sick		1.3	1.3	1.5	2.3	4.1	4.6	3.2	4.0	3.0	4.0	2.8	3.7
	S.D.	.9	.5	1.2	2.0	1.7	1.9	1.7	1.6	1.7	1.9	1.6	2.0
Arousing		2.2	1.6	1.9	2.6	6.0	5.5	5.9	5.7	5.9	5.7	5.9	5.2
	S.D.	1.5	.5	1.0	1.6	.8	.8	.8	.6	.9	1.0	.9	1.0
Piercing		1.4	1.5	1.7	1.9	5.0	5.2	5.4	4.4	5.2	4.6	4.4	4.5
	S.D.	.9	1.2	1.7	1.2	1.4	1.8	1.5	1.9	1.3	1.8	1.7	1.9
Discomforting		1.5	1.7	1.8	2.8	5.9	5.5	6.0	5.5	5.5	5.6	5.7	5.4
	S.D.	1.0	1.0	1.2	1.6	.7	.9	.8	.7	1.1	.8	.9	1.1
Aversive		1.4	1.4	1.3	2.1	5.4	5.1	5.3	4.7	5.5	4.8	5.0	4.0
	S.D.	.9	.9	.9	1.4	1.2	1.2	1.4	1.4	1.1	1.5	1.6	2.0
Distressing		1.0	1.1	1.1	2.3	5.4	5.2	5.1	5.0	4.4	5.2	4.8	4.9
	S.D.	.1	.3	.3	1.7	.8	1.1	1.9	1.3	2.0	1.0	1.8	1.1

[A] Experienced caregivers (mothers)

[B] Nonmothers

vocalization x risk x group interaction, $\underline{F}(2, 42) = 3.22$, $\underline{p} < .05$. These findings reflected the fact that the coos which served as a control for fullterm cries received less positive ratings from nonmothers than the coos which served as control for preterm cries. A significant vocalization x risk interaction, $\underline{F}(2,42) = 3.99$, $\underline{p} < .03$ also qualified the main effect of risk on the "Discomforting" scale. It reflected the fact that preterm control coos were given more positive ratings than fullterm control coos. Finally, there was a significant vocalization x group interaction, $\underline{F}(1,21) = 4.91$, $\underline{p} < .04$ on the "Distressing" scale, and a significant vocalization x risk interaction, $\underline{F}(2,42) = 3.95$, $\underline{p} < .03$, again reflecting less positive ratings for fullterm control coos than for preterm control coos.

All eight analyses were repeated for cry ratings only. They revealed no main effects or interactions except for one of the eight scales. There was a main effect of vocalization type on the "Urgent" scale, $\underline{F}(1,21) = 5.42$, $\underline{p} < .03$. This finding reflected the fact that preterm cries were rated as more urgent than fullterm cries.

Caregiving Choices. Separate analyses of variance were performed on each dimension with infant experience group as a between-subjects factor and vocalization type and risk level as within-subjects factors.

The analysis of the scores on the dimension "how immediately effective the response is at terminating the crying" revealed no main effects of infant experience group, vocalization type, or risk level, or any interactions.

The analysis of the scores on the dimension "how tender and caring the response is" revealed no main effects of infant experience group, vocalization type, or risk level, but a significant vocalization x group interaction, $F(1,16) = 6.19$, $p < .02$. The interaction, along with verification from subsequent Scheffé tests, reflected the fact that mothers and nonmothers did not differ in their responses made to the fullterm cries, but differed markedly in their responses to the preterm cries. Mothers chose responses for the preterm cries that they considered much more tender and caring than nonmothers did ($p < .05$).

Subjective Arousal Level. The analysis of variance of the subjective arousal level scores was conducted with infant experience group as a between-subjects factor and vocalization type, risk level, and period (pre as opposed to post) as within-subjects factors. The ANOVA source table is contained in Appendix G. This analysis, like the analysis of the Zeskind and Lester scales, also revealed a different response to coos and cries, and no effect of maternal experience. Significant main effects were obtained for risk, $F(2,38) = 79.97$, $p < .00001$, and response period, $F(1,19) = 130.55$, $p < .00001$, which were both qualified by a risk x period interaction, $F(2,38) = 51.54$, $p < .00001$. The interaction reflected the fact that cries of both risk levels induced feelings of increased arousal, while coos elicited no change in self reports of arousal ($p < .01$).

Psychophysiological Measures

Blood Pressure. Preliminary analyses of the blood pressure measures revealed different prestimulus levels of diastolic blood pressure for mothers for the different vocalizations, as well as different prestimulus levels of diastolic blood pressure for mothers and nonmothers. To eliminate the confounding effect of different prestimulus levels, change scores were computed by subtracting each prestimulus score from the score during stimulation, as well as by subtracting each prestimulus score from the score post stimulation. Separate analyses were then carried out on stimulation change scores and post stimulation change scores, with infant experience group as a between-subjects factor, and vocalization type and risk level as within-subjects factors.

The analysis of systolic blood pressure stimulation change scores revealed no main effects of infant experience group, vocalization type, or risk level, or any interactions. The analysis of post stimulation scores revealed a main effect of risk, $F(2,36) = 3.15$, $p < .05$, and no main effects of infant-experience group, vocalization type or any interactions. The main effect of risk reflected the fact that while there was only a negligible decrease in systolic blood pressure following coos, there was a marked decrease following the high-complications cries, and a marked increase following the low-complications cries.

The analysis of diastolic blood pressure stimulation change scores revealed no main effects of infant experience group, vocalization type or risk, or any interactions. The analysis of post stimulation change scores revealed no main effects of infant experience group, vocalization type, or risk, but a significant risk x group interaction, $F(2,36) = 5.47$, $p < .01$. The interaction reflected the fact that both groups showed negligible decreases in diastolic blood pressure after coos, but differed markedly in the change elicited following the low-complications, as well as the high-complications cries. Mothers showed a marked increase in DBP following low-complications cries and a marked decrease following high-complications cries. Nonmothers showed a decrease in DBP following low-complications cries and no change in DBP following high-complications cries.

Heart Rate. Preliminary analyses of heart rate indicated that only the initial prestimulation baseline was uncontaminated. Preliminary analyses also revealed a difference in general level of heart rate between mothers and nonmothers. To eliminate the confounding effect of different prestimulus levels of heart rate, change scores were computed by subtracting each of the first 10-s of the six vocalization segments from the corresponding second of the 10-s baseline period. Analyses of variance of heart rate were then conducted separately for cry vocalizations and for coos.

Coos were analyzed with infant experience group as a between-subjects factor, and stimulus control block (preterm control/fullterm control) and seconds as within-subjects factors. The analysis of coos yielded no significant main effects of infant experience group, control block, or seconds, or any interactions.

Cry vocalizations were analyzed with infant experience group as a between-subjects factor and vocalization type, risk level (low-complications/high-complications), and seconds as within-subjects factors (see Appendix H for the ANOVA source table). The analysis revealed no main effects of infant experience group, vocalization type, risk or seconds. There were, however, several interactions. A significant vocalization x group interaction, $\underline{F}(1,21) = 6.29$, $\underline{p} < .02$ was qualified by a significant vocalization x risk x group interaction, $\underline{F}(1,21) = 9.88$, $\underline{p} < .005$. There was also a significant vocalization x seconds interaction, $\underline{F}(9,189) = 6.08$, $\underline{p} < .00001$, which was qualified by a vocalization x risk x seconds interaction, $\underline{F}(9,189) = 2.75$, $\underline{p} < .005$. Finally, there was a 4-way vocalization x risk x seconds x group interaction, $\underline{F}(9,189) = 1.91$, $\underline{p} < .05$. As shown in Figure 2, these findings reflected the fact that

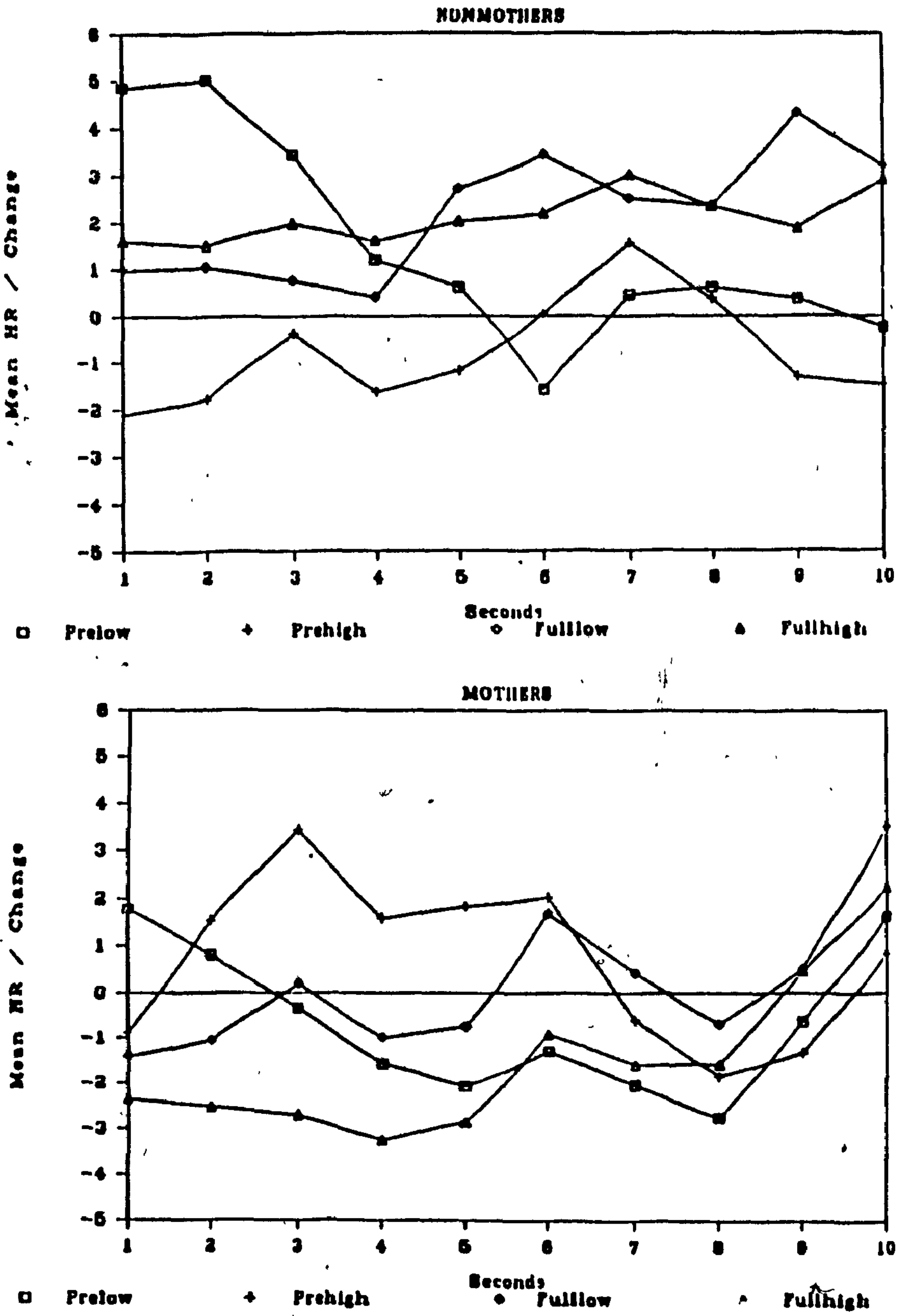


Figure 2. Interaction of vocalization by risk by group by seconds for mean heart rate change (BPM).

mothers responded to the high-complications preterm cries with a sharp rise in heart rate from 2 to 3 s followed by a sharp decline to 4 s, but their heart rate then levelled off before returning to a level below baseline; nonmothers responded with a slow rise peaking at 7 s. Mothers and nonmothers responded to the low-complications preterm cries with a decrease in heart rate beginning from levels above baseline. This effect was more marked in nonmothers. Subsequent Scheffé tests verified that mothers' heart rate elicited by the high-complications preterm cries at 1 and 3 s differed significantly ($p < .01$).

Discussion

The data indicated that coos were perceived as pleasant, while cries were perceived as unpleasant. Coos were rated favourably on all the Zeskind and Lester scales, while cries were rated as moderately aversive. Moreover, this effect was also evident in the subjective arousal level data. Cries of all types induced moderate feelings of arousal, while coos elicited no change in feelings of arousal. Both the cry perception data and the subjective arousal level data, therefore, support the predictions made regarding the effect of coos versus cries, and are consistent with the findings of Bryan et al. (1984).

Coos and cries also elicited different blood pressure and heart rate responses. The fact that only negligible blood pressure changes occurred after coos, while marked changes occurred after cries, suggests that coos were not arousing. This finding is comparable to other reports in the literature (Frodi & Lamb, 1978; 1980; Frodi et al., 1978a) that in contrast to blood pressure changes that occurred during cries, during presentation of infant smiles and coos negligible changes occurred. Since no effects were found during presentation of the stimuli in the present study, however, the blood pressure findings must be interpreted with caution. Blood pressure baseline, stimulation, and poststimulation readings were obtained over a fairly short time interval (90-s). This time span proved problematic in many instances for the automated blood pressure monitor, since there was some delay between the triggering of the monitor and obtaining a blood pressure reading. Consequently, periods in which the actual readings were obtained tended to overlap. This overlap may have served as a source of contamination -- possibly masking any effects due to the vocalizations.

Similarly, the finding that coos elicited no change in heart rate, while cries essentially did, appears to provide further support for the prediction that a difference would emerge between coos and cries on the physiological measures when cries were selected for their unique characteristics. It is not clear, however, why coos elicited virtually no response, in contrast to a difference in pattern of response from cries. This finding was not expected, and is problematic. Consequently, like the blood pressure finding, the heart rate finding for coos must be interpreted with caution. Order of presentation of the coos was not systematically varied in the present study, which is acknowledged to be a methodological confound. On the other hand, the response to coos across the subjective and the physiological measures does reveal a consistent pattern.

High-risk preterm cries were not perceived as especially aversive in comparison to the low-risk preterm and low-risk fullterm cries. In addition, no support was found for the prediction that high-risk cries would elicit caregiving responses perceived to be more "immediately effective in terminating the crying," and induce more feelings of increased arousal than the low-risk preterm and low-risk fullterm cries. Instead, the only difference found in the perception of cries was in the "urgency" of preterm cries compared to fullterm cries, and in addition, preterm cries also elicited from mothers more "tender and caring" responses than fullterm cries. The finding, in particular, that high-risk preterm cries were not perceived as more aversive than low-risk preterm and low-risk fullterm cries is inconsistent with the findings of Friedman et al. (1982). Friedman et al. previously reported that moderate-risk preterm cries were consistently rated more negatively than both low-risk preterm cries and fullterm cries. It should be noted, however, that Friedman et al. (1982) investigated pain cries, while the present study employed spontaneous cries. Perhaps information about risk is conveyed only in a subtle way in the spontaneous cries of infants. This would suggest that in the case of the spontaneous cry more fine grained or sensitive subjective measures may be required.

This interpretation is also supported by the fact that the present study did not replicate the findings of several studies (Zeskind & Lester, 1978; Zeskind, 1980; 1983; Zeskind & Huntington, 1984) that reported that the pain cries of high- and low-risk fullterm infants were differentiated in terms of subjective perceptions and caregiving responses.

Notwithstanding, it is also possible that the sharp contrast between coos and cries served to mask the differences among cries. This possibility gains some credence from two studies which investigated the same sample of spontaneous cries of temperamently "difficult," "average," and "easy" infants, and reported differentiation among cries on subjective measures similar to the ones used in the present study (Boukydis & Burgess, 1982; Lounsbury & Bates, 1982). At the same time, it is important to note that these infants were not defined according to neonatal history of medical risk, but by temperament.

Although the blood pressure measure did not differentiate the high-risk preterm cries from the low-risk preterm and the low-risk fullterm cries, heart rate did. This finding provides partial support for the prediction regarding the physiological pattern that would be elicited by the high-risk preterm cries. Moreover, the heart rate findings provided some support for the prediction that the effects would be stronger in mothers than nonmothers.

The heart rate data indicated that both mothers and nonmothers discriminate between high- and low-risk preterm cries. The fact that mothers reacted to the onset of the high-risk preterm cries with marked cardiac acceleration, however, suggests that they are especially sensitive to cry characteristics that convey information about risk. Our findings conflict with Wiesenfeld et al. (1981), who reported that cardiac deceleration was the typical response exhibited by mothers to an unfamiliar infant's cry, while the cry of the mother's own infant elicited a unique pattern of cardiac acceleration. The present findings make clear that cardiac acceleration is not a unique response which is elicited only by one's own infant cry. It is possible that the cardiac acceleration shown in the Wiesenfeld et al. study in response to a strange infant's cries could have resulted from the identification requirement of the task. If, in an experimental context, a mother recognizes her own infant's cries, her response to these familiar cries could conceivably interact with, or even overshadow reactivity to other unfamiliar infant vocalizations.

In conclusion, these findings speak clearly to the issues that were addressed. Regarding the relationship between medical risk and the perceived aversiveness of preterm cries, there was no evidence of an association between these on the basis of the subjective measures that were employed in the present study. However, this failure to find an association between medical risk and perceived aversiveness was interpreted only to reflect the fact that in contrast to the pain cry, in the spontaneous cry, "risk" characteristics may be manifested in a more subtle way. Consequently, differences among the spontaneous cries of infants may be more difficult to detect, and may emerge only through very fine grained subjective measures.

On the other hand, one physiological measure, heart rate, proved to be particularly sensitive, since it differentiated between the low- and high-risk preterm cries. It did not, however, differentiate the spontaneous cries of low- and high-risk fullterm infants. Thus, another possibility is that information about "risk" is conveyed differently for preterm and fullterm infants. In contrast to preterm infants, it is possible that for fullterm infants, it is <u>only</u> the pain cry that conveys unambiguous information about "risk status."

The findings of the present study also suggest that maternal experience influences women's caregiving and heart rate responses to preterm cries. The latter finding makes clear that "relatedness to the infant" is only one factor that affects the direction of mothers' heart rate response to cries. Caution should therefore be exercised when making general statements about the response pattern elicited by infant signals.

Finally, the question regarding the significance of cardiac acceleration remains unanswered. The systematic change in mothers' heart rate during the high-risk preterm cries is consistent with what has been termed a "defensive" response (Graham & Clifton, 1966). However, the absence of any perceived aversiveness, increased arousal levels, or any covert behavioral intentions suggesting that mothers wanted to "immediately" terminate the high-risk preterm cries, make it difficult to equate the heart rate response exhibited by mothers to the "defensive" response. Further research is, therefore, required to determine the significance of cardiac acceleration in response to cries, and the conditions under which it can be elicited. The second experiment examines these issues.

Experiment 2

The results of the first experiment did not contribute significantly to an understanding of the meaning of cardiac reactivity patterns, since no direct relationship was established between self reports and cardiac responses for either mothers or nonmothers. Response patterns, however, were seen to differ for these groups, with mothers' caregiving and heart rate responses evidencing some consistency. In a recent study (Zeskind, 1980) it was suggested that mothers' cognitions, through experience with infants, allows them to translate differential perceptions of cries into decisive actions. The findings from Experiment 1 supports this notion. Furthermore, this cognitive process seems to be linked, to some degree, to cardiac reactivity patterns. While these data are merely suggestive, they do implicate cognitions as a possible factor influencing cardiac reactivity to cries. Thus, a systematic analysis of the role cognitive factors play in the cardiac response elicited by cries seems warranted, since this may provide a handle on the significance of cardiac responses.

The second experiment, therefore, had two purposes. First, the study was designed to determine the robustness of the cardiac response elicited by the high-risk preterm cries. It was felt that before a general statement about the physiological response pattern elicited by high-risk preterm cries could be made, it was essential to first determine the stability of the response elicited by these cries. One goal of the study, thus, was to systematically replicate the heart rate changes seen in Experiment 1 with a more carefully selected group of subjects, and with a more refined methodology. A second goal was to explore the modifiability of cardiac changes to infant vocalizations, namely, could heart rate be altered by providing subjects with a particular cognitive set? The basic assumption was that if cardiac acceleration could be manipulated, it may provide some insight regarding what cardiac acceleration in the context of infant crying reflected. It was hoped that the acceleratory cardiac pattern, typically exhibited by mothers, could be induced in the inexperienced women by providing them with information on specific characteristics about the infants. Such effects might shed light upon the role cognitive factors play in the cardiac response to cries.

One way of providing a cognitive set is through labeling. Two studies have reported on the impact of labeling upon reactivity to cries. Frodi et al. (1978a) first showed that labeling effectively influenced parents' perceptions of cries. Moreover, Frodi et al. (1978a) also reported significant physiological changes indexed by increases in skin conductance as a function of the label "premature." Subsequently, Donovan and Leavitt (1984) reported that mothers with prior experience on an instrumental task with a cry labeled as "difficult," responded with poor performance on a subsequent cry termination task. The effect of labeling on heart rate response to cries has not been investigated.

Experiment 2, therefore, consisted of two trials: a baseline or no information trial, and a labeling trial designed to effect a change in response patterns. Thus the high- and low-risk cries were presented on the first trial in the absence of any specific cognitive set, and on the second subsequent trial, were presented in one of three conditions: 1) correctly labeled as a function of the infants' risk (high/sick; low/healthy) and gestation (preterm/fullterm) status; 2) incorrectly labeled; and 3) without label (control group). The correct, incorrect, and no label cries were presented to equal proportions of the sample of subjects, to determine whether the differential reactivity to same stimuli could be elicited. Risk status was defined as "sick" and "healthy" because it was felt that this label would have more immediate significance for the subjects. Since one goal of the study was to replicate the findings from Experiment 1, the same 16 high- and low-risk preterm and fullterm cries were presented in Experiment 2.

Experiment 2 also differed from Experiment 1 in several important ways. Regarding the issue of subject selection, Frodi et al. (1981) previously showed that mothers of preterm infants, and mothers of fullterm infants respond somewhat differently on psychophysiological measures. Mothers of preterm infants exhibit hyperreactivity. Consequently, Experiment 2 controlled for this factor by investigating primarily mothers of fullterm infants. In addition, in order to make the study comparable to other reports in the literature, mothers of one infant, 13 months of age or younger, were investigated. Further, an attempt was made to address some of the methodological issues which were raised in Experiment 1. For instance, to explore the possibility that the failure to find differences among cries on the subjective measures was attributed to the contrast effect created by coos, coos were not included as stimuli in Experiment 2. It was thought that if coos did mask differences among cries, then in the absence of coos, differences among cries might emerge more readily.

With regard to the measures employed, the Zeskind and Lester rating scales, the Zeskind Caregiving Choices, and the general index of arousal level were all retained, since in the absence of coos, the sensitivity of these measures might change. Blood pressure was not investigated in Experiment 2 because unlike heart rate it did not differentiate meaningfully between the high- and low-risk preterm cries, or between the high- and low-risk fullterm cries. Finally, the method of monitoring heart rate was refined by incorporating a computer assisted digitized data-logging procedure.

It was hypothesized that in the absence of coos, the high-risk preterm cries would be perceived as more aversive, and elicit caregiving responses which are perceived as more "immediately effective in terminating the crying" than low-risk preterm and low-risk fullterm cries. Again no hypothesis was formulated for the "tender and caring" caregiving dimension. In addition, it was hypothesized that high-risk preterm cries would elicit greater increases in arousal levels, and as in Experiment 1, elicit marked cardiac acceleration compared to low-risk preterm and low-risk fullterm cries. Mothers were again expected to show stronger effects than nonmothers. As in Experiment 1, no hypotheses were formulated about the effects of the high-risk preterm cries in contrast to the high-risk fullterm cries, as well as about the effects of the low-risk preterm cries in contrast to the low-risk fullterm cries.

Few specific predictions were made concerning labeling, since this aspect of the experiment was essentially exploratory in nature. With regard to ratings on the Zeskind and Lester scales, it was hypothesized that mothers given the correct labels would increase their negative ratings of the high-risk preterm cries; negative ratings were also expected for the high-risk fullterm cries. In addition, both these cries were expected to elicit caregiving responses perceived as more "immediately effective in terminating the crying," and induce increased feelings of arousal in mothers given the correct label. No predictions were made on these measures regarding the effect of labeling on mothers in the incorrect or reversed (e.g., high-risk preterm/healthy fullterm) label condition. Nonmothers given the correct label were expected to evidence a similar pattern on the subjective measures as mothers given the correct label. Nonmothers given the reversed labels were also expected to exhibit the same pattern of response as mothers in the <u>correct</u> label condition, but to the low-risk preterm cries (labeled sick fullterm) and to the low-risk fullterm (labeled sick preterm) cries.

With respect to heart rate, mothers given the correct labels were expected to exhibit greater cardiac acceleration on trial 2 to the high-risk preterm cries than on trial 1. A pattern of cardiac acceleration elicited by the high-risk fullterm cries, was also expected in mothers given the correct label. Similarly, nonmothers given the correct labels were also expected to show a pattern of cardiac acceleration to the high-risk preterm cries, as well as to the high-risk fullterm cries. Again no specific predictions were made regarding the patterns that would be elicited by the two high-risk cries in mothers when they were given the reversed label. Like the predictions on the subjective measures, however, nonmothers given the reversed labels were expected to show cardiac acceleration to the low-risk preterm, and to the low-risk fullterm cries. Finally, it was predicted that there would be no change on any measure across trials for subjects in the no label condition.

Method

Subjects

Subjects were again two age-matched groups of Caucasian middle-class English speaking females, solicited through advertisements placed in newspapers. One group consisted of 24 primiparous mothers ($\bar{X}$ age = 27.9 years; age range = 20 - 36 years) each with a fullterm infant (one infant was four weeks premature), thirteen months of age or under ($\bar{X}$ age of infant = 7.3 mos; age range = 2.5 - 13 mos). The second group consisted of 24 nonmothers ($\bar{X}$ age = 26 years; age range = 20 - 39 years) with no prior caretaking experience of an infant for as long as two weeks. All subjects received $15 as remuneration.

Apparatus

The experimental room and equipment remained similar to that described in Experiment 1 with the following changes. The analog output from the Beckman 511A Dynograph and Sony TC-630 (sound processed through an EMG coupler; Type 9852A) recorders were fed into a Transduction (Model No. PCB-00819) board, mounted in an IBM PC chassis. This configuration provided digitalized readings of heart rate, as well as the auditory stimuli. In addition, located at floor level, approximately 90 cm away and slightly right of the armchair in which the subject was seated, was a Sony stereo speaker (Model No. RD-5) over which the stimuli and all instructions were now presented. Finally, the blood pressure recordings which were obtained in Experiment 1 were not included in the present experiment.

Stimulus Material and Design

Stimuli consisted of the same 16 infant cries used in Experiment 1. Four sets of four, or 16 experimental tapes (Scotch 3M Audio Recording Tape) were now generated. The first four tapes (A1-4), as in Experiment 1, each consisted of 4 different 30-s cries: one high- and one low-complications preterm infant cry, and one high- and one low-complications fullterm infant cry. However, order of tapes A1-4 was now systematically varied to meet the requirements of balanced randomized latin square (each order consisting of the cries of four different infants). Thus, for example, of the four low-risk preterm recordings, one may have occurred first on tape A1, another may have occurred second on tape A2, the third, third on tape A3, and the fourth, fourth on tape A4. In addition, there was the constraint that no two preterm or no two fullterm cries were played in succession (Table 2 contains the four sequences of the latin square that were used). Each of tapes A1-4 had an identical second, third, and fourth tape (B1-4, C1-4 and D1-4, respectively) consisting of the same four cries recorded in the same sequence. Cries on tapes B1-4, however, were correctly labeled on tape, while cries on tapes C1-4 were incorrectly labeled. Finally, cries on tapes D1-4, like cries on tapes A1-4, were not labeled.

Tapes A1-4 began with a series of instructions followed by a practice trial consisting of the two infants' cries used in Experiment 1. Like Experiment 1, these two cries (1 30-s segment of a fullterm infant cry and another segment of a preterm infant cry) were not included in the experimental stimuli. The four experimental stimuli were separated by 5-min interstimulus intervals (ISI), and a 5-min interval separated the practice trial from the first segment of experimental stimuli. The 5-min ISI was a change implemented in contrast to the 3-min ISI employed in Experiment 1 because contamination of heart rate baselines for the different vocalizations was detected in Experiment 1. All instructions given on tapes A1-4 were summarized and repeated on tapes B1-4, C1-4, and D1-4 with the exception of the practice trial. Tapes B1-4 and C1-4 also contained additional identical instructions.

Table 2

Sequences Employed for Stimulus Tapes

	Orders			
Subject	1[a]	2[b]	3[c]	4[d]
1 - 12	HF	LP	LF	HF
13 - 24	LP	LF	HP	HF
25 - 36	LF	HP	HF	LP
37 - 48	HP	HF	LP	LF

[a]Order for Tapes A1, B1, C1, D1

[b]Order for Tapes A2, B2, C2, D2

[c]Order for Tapes A3, B3, C3, D3

[d]Order for Tapes A4, B4, C4, D4.

Interstimulus intervals were also of 5-min durations for all the B, C, and D tapes.

Measures

The scoring of the subjective arousal level (SAL) ratings on the eight Zeskind and Lester scales (Z & L scales), as well as the six Zeskind caregiving choices remain as outlined in Experiment 1.

Heart Rate. Cardiac response was determined online by the computer which measured interbeat intervals in milliseconds and subsequently converted them to heart rate in beats per minute. The last 10 s preceding each experimental stimulus constituted baselines for comparison to each of the first 10 s of the corresponding stimulation period.

Procedure

Instructions requesting that the subject not engage in any strenuous exercise, coffee drinking, or smoking for a minimum of two hours prior to the experiment were again given. Each subject was tested in a single 90-min test session, each session consisting of two trials. Each subject heard four infants' cries repeated over two trials. All subjects heard one of tapes A1-4 on trial 1, followed by one of either tapes B1-4, C1-4, or D1-4 on trial 2. For example, subject may have heard either A1/B1, A1/C1, or A1/D1. Thus, on trial 1 six mothers and six nonmothers heard the same four infants' cries on one of the first four experimental tapes A1-4. Subsequently on trial 2 two mothers and two nonmothers were randomly assigned to one of tapes B1-4, C1-4, and D1-4, where they listened to the same four cries previously heard. Upon arrival the subject was taken to the preparatory room where she was seated and encouraged to relax. The procedure was explained to her in terms of the various indices being measured and the number of trials involved, but care was taken to withhold the specific purpose of the study. Following preparation of the skin with alcohol, the electrodes were affixed to the appropriate areas, and the subject was asked to fill out the brief demographic questionnaire as in Experiment 1. The subject's blood pressure was then checked as a precautionary measure to rule out any cardiovascular disease. The subject was then shown into the experimental chamber where after being seated in an armchair facing the panel of lights, she was attached to the polygraph for continuous heart rate readings. Following the 5-min adaptation period, stimuli were presented, and all subsequent instructions were communicated to the subject over the speaker. Appendix I contains the instructions which were given to all subjects prior to trial 1. The instructions which were given to subjects prior to trial 2 are contained in Appendix J. On trial 1, the subject was instructed to indicate her arousal level before and after each cry by turning the dial below her right hand. She was also instructed to rate and select a caregiving response for each cry during the first minute of silence that followed the cry. Clear instructions and a demonstration was given with respect to filling out the rating scale and indicating subjective arousal level. The practice trial consisting of two infant cries was then given, followed by a 5-min rest period during which the subject was encouraged to relax. Prior to the presentation of the experimental sounds on trial 1, all instructions regarding the task were again repeated. The presentation of the stimuli and the experimental protocol used are shown in Appendix K.

The instructions for trial 2 were given following a 10-min break. The basic instructions given on trial 1 regarding the subject indicating her arousal level, the ratings on the Zeskind and Lester scales, as well as selecting a caregiving response for each infant cry were repeated. In addition, the subject listening to cries on one of either tapes B1-4 or C1-4 was told that each of the four 30-s cries she heard represented one of the categories of: healthy preterm, sick preterm, healthy fullterm, and sick fullterm. The subject was told that before each cry was heard the identification would be given. Following these instructions the subject experienced 5 mins of silence, at the end of which she was told that the trial would begin. This was followed by another 4 mins of silence, then the subject was requested to indicate her arousal level, and the first experimental stimulus was identified. Another minute of silence followed at the end of which the first cry was presented. A third of the subjects in each group (8 mothers, 8 nonmothers) had the cries correctly identified: high-risk-preterm/sick preterm, low-risk preterm/healthy preterm, high-risk fullterm/sick fullterm, and low-risk fullterm/healthy fullterm. Another third of the subjects (8 mothers, 8 nonmothers) had the cries incorrectly identified: the two preterm cries were identified as fullterm cries and vice versa, and high-risk/sick was identified as low-risk/healthy and vice versa. For example, low-risk preterm was identified as sick fullterm. For the remaining 8 subjects in each group who essentially served as a control, following the instructions and a 4-min pause they were required to indicate their level of arousal, and after another minute of silence the first cry was presented without identification as in trial 1. Upon completion of the task subjects were requested to rank the caregiving responses for both trials. Subjects listening to the B and C tapes were also asked to rate on a scale of 1 to 7 how appropriate they felt the identification was for each cry. This rating scale, shown in Appendix L, was designed to determine whether the subject accepted the label given to a particular cry. Finally, all subjects were debriefed regarding the infants from whom the cries were recorded.

Results

Analyses for Trial 1 Scores Only

Subjective Measures

Analyses of variance were first conducted on each measure for trial 1 only, in order to determine whether the effects found for Experiment 1 were replicated, as well as to determine whether other effects among cries had emerged in the absence of coos.

Vocalization Ratings. Mean ratings of each type of cry as a function of risk level are presented in Table 3. Ratings of the cries on each of the Zeskind and Lester scales were subjected to separate analyses of variance with infant experience group as a between-subjects factor, and vocalization type, and risk level as within-subjects factors. None of the analyses revealed an effect of maternal experience, vocalization type, or risk level, and there were no interactions except on one of the eight scales. A significant risk x group interaction, $F(1,46) = 4.38$, $p < .04$ was revealed on the "Piercing" scale, which reflected the fact that mothers and nonmothers did not differ in their ratings of the high-risk cries, but differed in their ratings of the low-risk cries. Mothers rated the low-risk cries to be more "piercing" than nonmothers.

Caregiving Choices. Table 4 shows the means of the responses made to the cry types as a function of risk

Table 3

Means and Standard Deviations for Vocalization Ratings

Scale		Vocalization							
		Preterm Cries				Fullterm Cries			
		L Comp.		H Comp.		L Comp.		H Comp.	
Urgent		E[A]	I[B]	E[A]	I[B]	E[A]	I[B]	E[A]	I[B]
		4.7	4.5	4.7	4.5	4.7	4.5	4.3	4.3
	S.D.	2.1	2.1	1.7	2.1	1.7	1.7	1.7	1.9
Grating		5.2	5.0	4.7	5.2	4.9	4.9	4.9	4.9
	S.D.	1.3	1.5	1.3	1.1	1.2	1.3	1.1	1.4
Sick		3.2	3.0	3.0	2.9	3.4	2.8	3.8	3.1
	S.D.	1.7	1.9	1.3	1.6	1.6	1.6	1.6	1.9
Arousing		5.4	5.4	5.1	5.4	5.7	5.2	5.3	5.4
	S.D.	1.1	1.2	1.3	1.3	.9	1.3	1.0	1.3
Piercing		4.4	3.8	3.8	4.5	4.9	3.7	4.2	3.8
	S.D.	1.9	2.3	1.5	2.0	1.1	1.9	1.9	2.0
Discomforting		5.2	5.2	5.1	5.3	5.1	4.7	5.2	5.0
	S.D.	1.1	1.4	1.1	1.1	1.1	1.3	1.2	1.3
Aversive		4.6	4.1	4.6	4.0	4.3	4.4	4.1	3.9
	S.D.	1.5	1.9	1.4	1.9	1.3	1.5	1.3	1.5
Distressing		4.5	4.2	4.5	4.8	4.7	4.5	4.4	4.4
	S.D.	1.9	2.0	1.3	1.8	1.5	1.6	1.6	1.9

[A]Experienced caregivers (Mothers)

[B]Nonmothers

Table 4

Means and Standard Deviations for Caregiving Responses

Dimensions		Preterm Cries				Fullterm Cries			
		Vocalization							
		L Comp.		H Comp.		L Comp.		H Comp.	
		E[A]	I[B]	E[A]	I[B]	E[A]	I[B]	E[A]	I[B]
"Immediately effective in terminating the crying"		3.1	2.9	1.7	2.9	2.9	2.3	3.2	3.1
	S.D.	1.5	1.8	1.0	1.6	1.8	1.2	1.7	1.9
"Tender and caring"		3.1	3.3	2.0	2.7	3.1	2.5	3.7	2.9
	S.D.	1.3	1.6	.8	1.4	1.8	1.4	1.5	1.7

[A]Experienced caregivers (Mothers)

[B]Nonmothers

level. Separate analyses of variance were performed on each dimension with infant experience group as a between-subjects factor, and vocalization type, and risk level as within-subjects factors. The ANOVA source tables are presented in Appendix M.

The analysis conducted on scores for the dimension "how immediately effective the response is at terminating the crying" revealed no main effects. A significant vocalization x risk interaction, $F(1,42) = 8.46$, $p < .01$ was found, however, attributed to the fact that both preterm high-risk and fullterm low-risk cries elicited responses that were considered more "effective in terminating the crying" than responses elicited by the fullterm high-risk and preterm low-risk cries. Scheffé tests, however, indicated no significant differences between the "effectiveness" of the responses made for the cry types. Two interesting trends approached significance. A vocalization x group trend, $F(1,42) = 3.12$, $p < .08$ indicated that mothers chose responses that they considered more "effective in terminating the crying" for preterms than for fullterms, while nonmothers chose responses that they considered equally "effective" for both cry types. A risk x group trend, $F(1,42) = 3.32$, $p < .07$ revealed also that mothers considered their responses chosen for the high-risk cries as much more "effective" than their responses chosen for the low-risk cries, while nonmothers did not differ in the responses they made to cries of the two risk types.

The analysis on the dimension "how tender and caring the response is" also revealed no main effects. There was, however, a significant vocalization x group interaction, $F(1,42) = 9.53$, $p < .004$. The interaction, along with subsequent Scheffé tests, revealed that mothers chose responses for the preterm cries that they believed were more "tender and caring" than the responses they chose for the fullterm cries ($p < .01$), while nonmothers did not differ in their responses made to the two cry types. The vocalization x risk interaction was also significant, $F(1,42) = 10.74$, $p < .002$, and was attributed to preterm high-risk cries eliciting the most "tender and caring" responses of the four cry types. Scheffé tests, however, indicated significant differences between the responses for preterm high-risk and preterm low-risk cries, and between preterm high-risk and fullterm high-risk cries ($p < .05$ in each case), but not between the responses made to the preterm high-risk and the fullterm low-risk cries.

<u>Subjective Arousal Level</u>. The analysis of variance of subjective arousal level was conducted on change scores computed for each cry type by subtracting the appropriate pre arousal level score from the post score. The analysis conducted with infant experience group as a between-subjects factor, and vocalization type, and risk

level as within-subjects factors, yielded no significant main effects or any interactions.

Psychophysiological Measure

Heart Rate. The analysis of variance of heart rate was conducted on change scores which were computed by subtracting each of the 10 s immediately preceding each cry from each of the first 10 s of the corresponding cry. The analysis was conducted with infant experience group as a between-subjects factor, and vocalization type, risk level and seconds (10) as a within-subjects factor (see Appendix N for the ANOVA source table). No main effects of infant experience group or risk level were found. Significant main effects, however, were found for vocalization type, $F(1,46) = 6.39$, $p < .01$, and seconds, $F(9,414) = 8.46$, $p < .00001$. The effect of vocalization was attributed to a slight increase in level of heart rate elicited by preterm cries, while fullterm cries elicited a decrease in level of heart rate. The main effect of seconds was qualified by a group x seconds interaction, $F(9,414) = 2.35$, $p < .01$, reflecting differences in the cardiac response patterns exhibited by mothers and nonmothers over the first 2 to 5 s of stimulation. As shown in Figure 3, mothers responded to the cries, overall, with a pattern characterized by a sharp decrease at 2 s, rising to a level slightly above baseline at 4 s, followed by a gradual decline to levels below baseline for the remaining 6 seconds. Nonmothers, on the

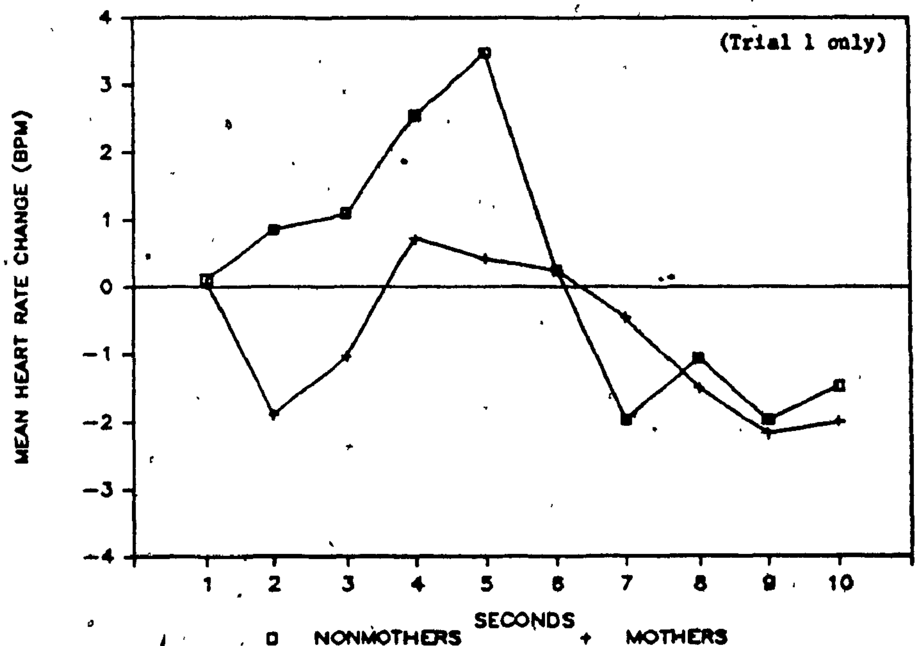
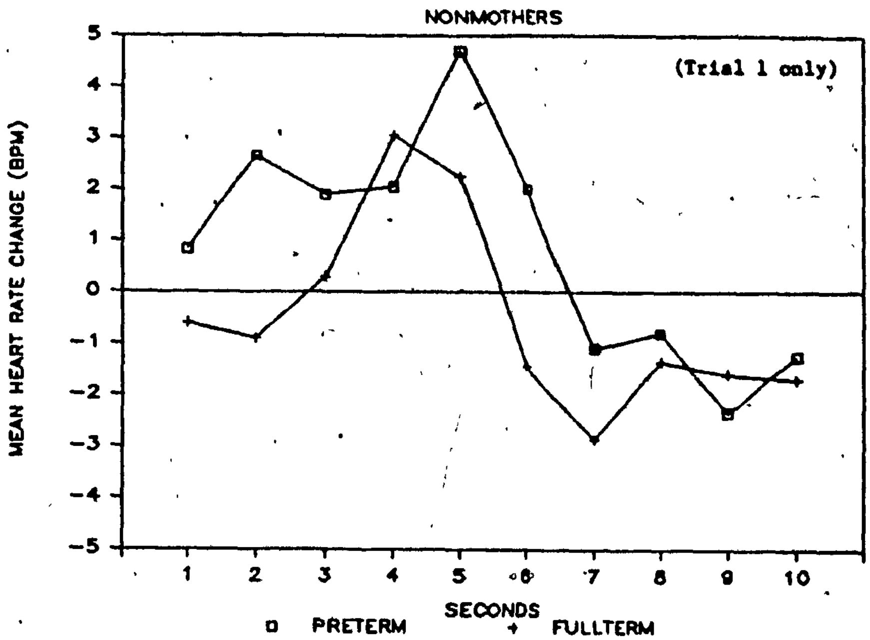


Figure 3. Trial 1: Interaction of group by seconds for mean heart rate change (BPM).

other hand, exhibited a pattern characterized by a steady rise that peaked at 5 s at a level way above baseline, a subsequent sharp decline to levels below baseline at 7 s, which was maintained for seconds 8, 9, and 10. Scheffé tests confirmed significant differences between the groups in heart rate, at 2 and 5 s ($p < .01$), and at 3 and 4 s ($p < .05$). Also revealed were some trends that approached significance: a main effect trend for risk level, $F(1,46) = 2.99$, $p < .09$, a vocalization x group x seconds trend, $F(9,414) = 1.79$, $p < .07$, and a risk x group x second trend, $F(9,414) = 1.69$, $p < .09$. The vocalization x group x seconds trend, displayed in Figure 4, reflected the fact that the mothers' initial response to the onset of fullterm cries was marked cardiac deceleration, while preterm cries elicited periods of unsustained cardiac acceleration; nonmothers, unlike mothers, exhibited a pattern characterized primarily by cardiac acceleration to both preterm and fullterm cries. The acceleratory pattern elicited by preterms in nonmothers, however, was much more marked than the pattern elicited by fullterms, since preterms elicited a peak at a higher level, and as well, there was some negligible decrease to the onset of the fullterm cries.

Similarly, the risk x group x seconds trend shown in Figure 5 reflected the fact that nonmothers exhibited primarily marked cardiac acceleration to cries of both risk



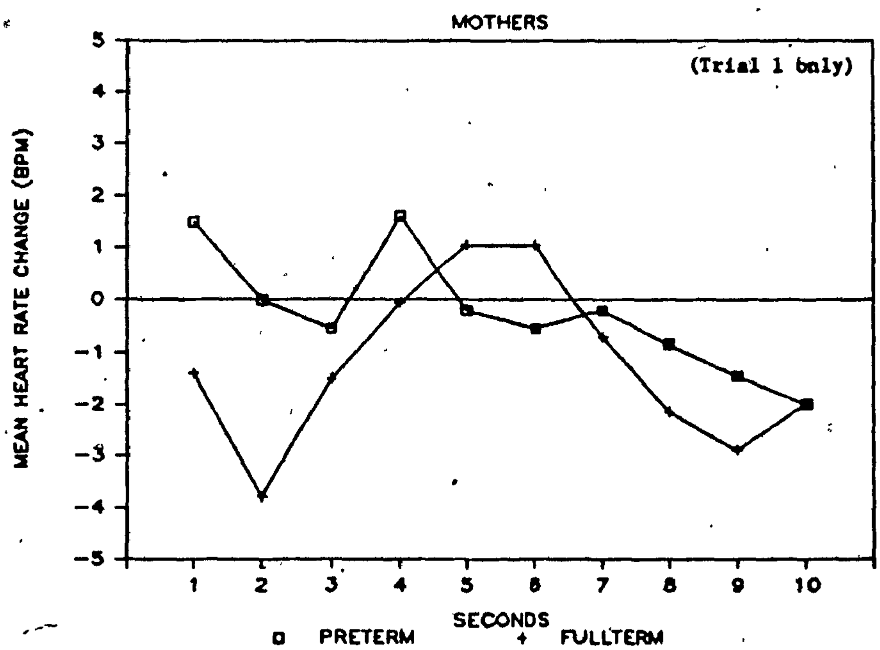


Figure 4. Trial 1: Vocalization by group by seconds trend for mean heart rate change (BPM).

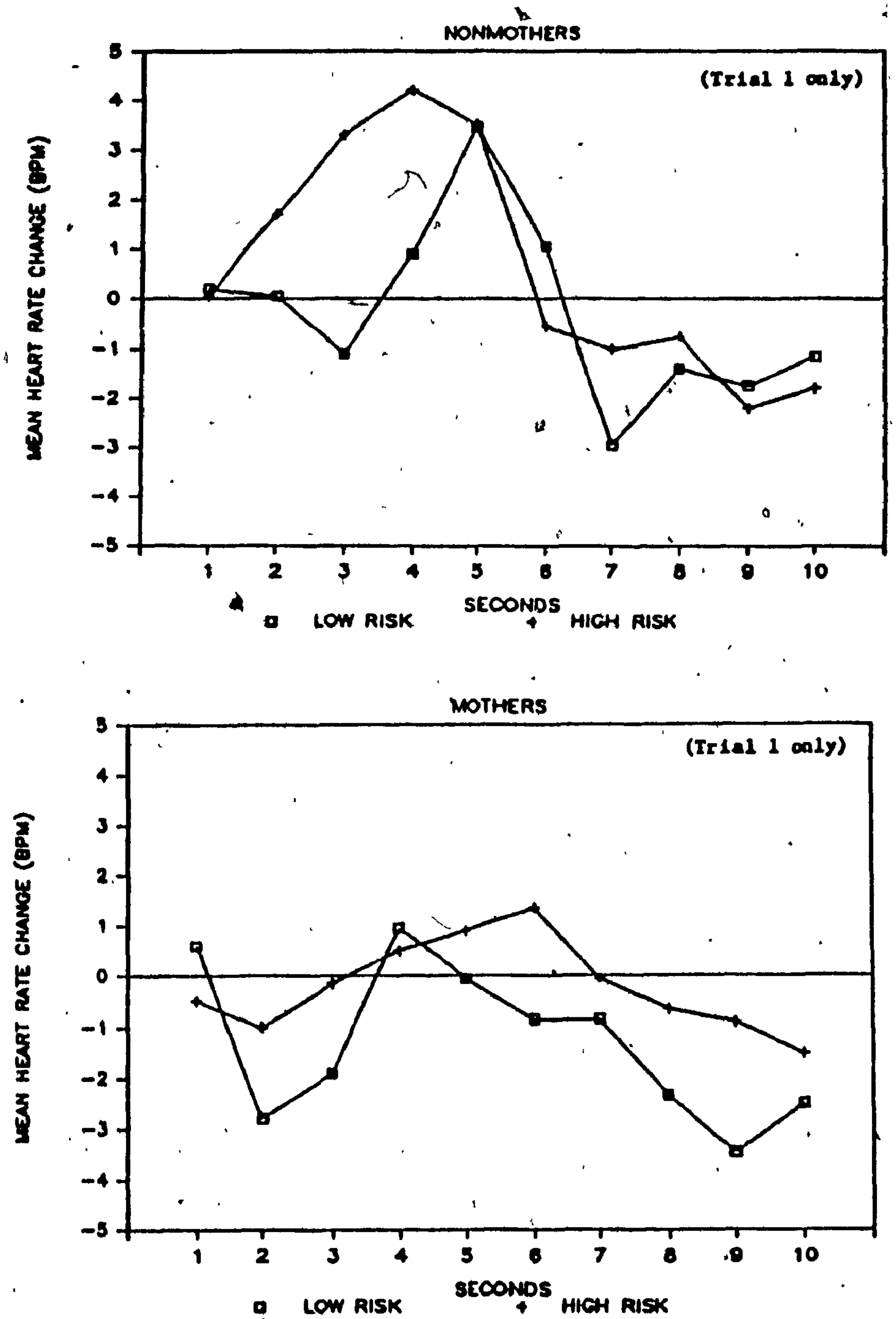


Figure 5. Trial 1: Risk by group by seconds trend for mean heart change (BPM).

types (although the onset of the low-risk cries did elicit negligible cardiac deceleration). Mothers, on the other hand, showed marked cardiac deceleration to the onset of the low-risk cries, while the pattern elicited by the high-risk cries was less well defined; the high-risk cries elicited in mothers a negligible decrease to the onset, followed by definite but only slight acceleration.

Analyses for Trial 1 and Trial 2 Scores

To determine whether a change was effected in the subjects' performance as a function of the labeling procedure, subsequent analyses were repeated for all measures with trials 1 and 2 included. Consequently, the analyses were conducted on data for the six subgroups (N = 8 per group) that were created on the basis of the random assignment of subjects to the three treatment conditions on trial 2. The analyses were conducted with infant experience group (2): mothers/nonmothers, and labeling condition (3): correct label (CL), incorrect label (INCL), and no label (NL) as between-subjects factors. Vocalization type, risk level, and trials (2), again served as within-subjects factors.

Subjective Measures

Vocalization Ratings. Ratings of the cries on each of the Zeskind and Lester scales were again subjected to separate analyses of variance. The analyses of variance indicated no effect of maternal experience, vocalization type, or risk level. The main effect of trial was significant on six of the eight scales with a nonsignificant trend on a seventh scale: Urgent, $F(1,42) = 8.11$, $p < .01$; Grating, $F(1,42) = 5.68$, $p < .02$; Sick, $F(1,42) = 31.93$, $p < .00001$; Piercing, $F(1,42) = 11.28$, $p < .002$; Discomforting, $F(1,42) = 8.57$, $p < .005$; Aversive, $F(1,42) = 7.07$, $p < .01$; and Distressing, $F(1,42) = 3.24$, $p < .08$. These effects are attributed to the fact that cries were generally rated more negatively on trial 2 than they were on trial 1. The main effect of condition was also significant on three scales: Grating, $F(2,42) = 4.15$, $p < .02$; Arousing, $F(2,42) = 4.03$, $p < .02$; and Discomforting, $F(2,42) = 4.31$, $p < .02$. Inspection of the means indicated that of the three conditions, subjects given the incorrect label consistently rated the cries least negatively. Scheffé tests confirmed differences between subjects' ratings, however, only for the incorrect versus the correct labeling conditions, $p < .01$, for the "Arousing" and "Discomforting" scales, and $p < .05$, for the "Grating" scale.

The analyses on seven of the eight scales also revealed a significant risk x trial x condition interaction, with a nonsignificant trend on the eighth scale: Urgent, $F(2,42) = 8.36$, $p < .001$; Grating, $F(2,42) = 3.37$, $p < .04$; Sick, $F(2,42) = 25.04$, $p < .00001$; Piercing, $F(2,42) = 4.09$, $p < .02$; Discomforting, $F(2,42) = 3.78$,

p .03; Aversive, $F(2,42) = 4.74$, $p < .01$; Distressing, $F(2,42) = 3.72$, $p < .03$; and Arousing, $F(2,42) = 3.05$, $p < .06$. The interaction on each scale (two of which are depicted in Figure 6) is attributed to the fact that while subjects in the no label condition rated the low- and high-risk cries equally unpleasant on trial 1, and made no significant changes in ratings of either type on trial 2, except for two scales, subjects in the labeling conditions rated the two risk types equally on trial 1, but consistently changed their ratings of a particular risk type on trial 2. On trial 2, subjects given the correct label either did not change their ratings of the low-risk cries, or else rated them less negatively, but they consistently rated the high-risk cries more negatively. For subjects given the incorrect (reversed) label the converse occurred. While their ratings of the high-risk cries on trial 2 either remained the same as on trial 1, increased (a significant increase was found on one scale), or decreased slightly, their negative ratings of the low-risk cries were consistently increased. Scheffé tests indicated significant differences between trials for the subjects' ratings of the high-risk cries, in the correct labeling condition, and for the low-risk cries, in the incorrect labeling condition on the scales: Urgent, Sick, Piercing ($p < .01$) in each case, and Discomforting ($p < .05$ & .01, respectively). On the "Grating" and "Aversive"

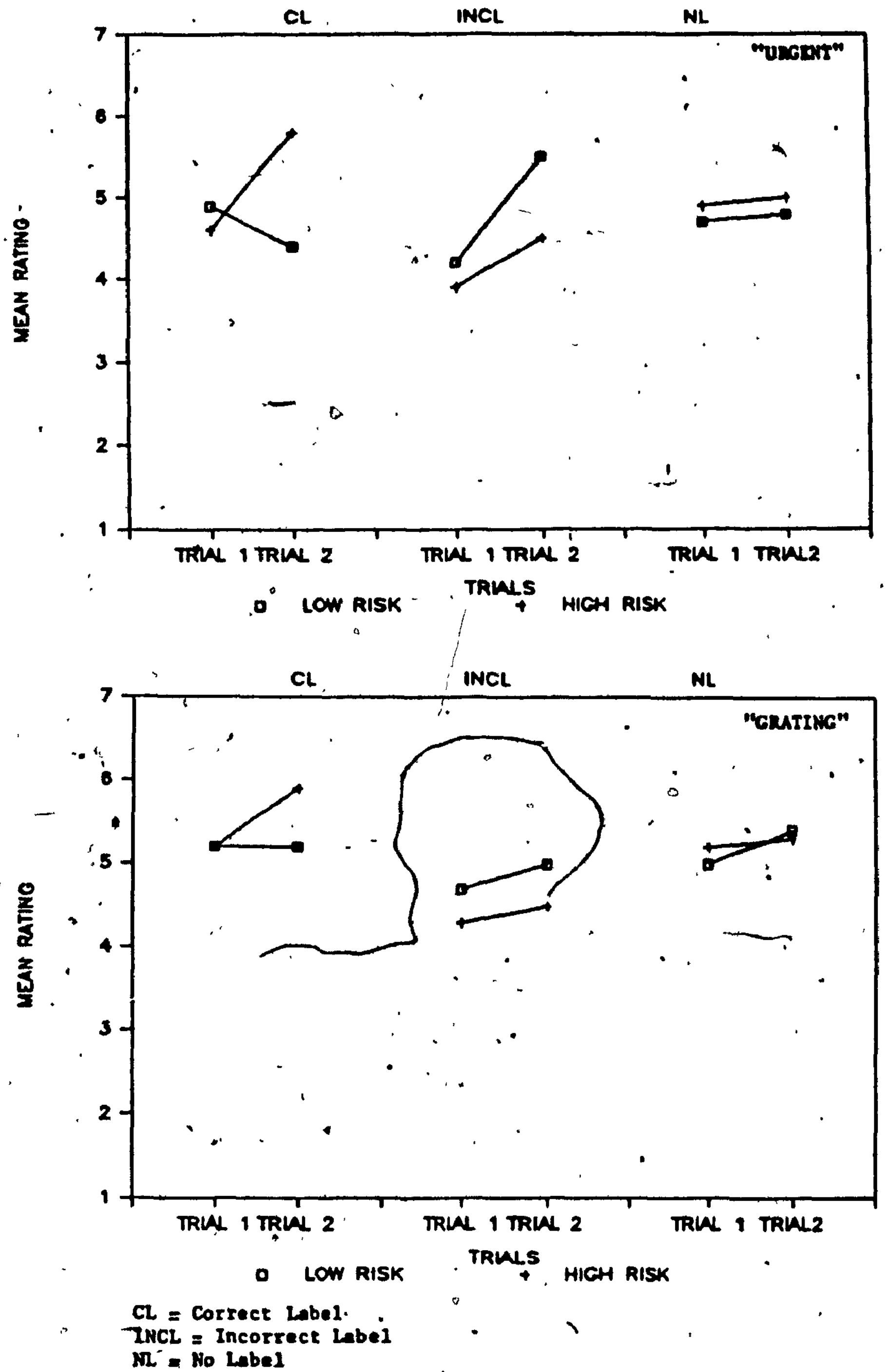


Figure 6. Trial 1 and 2: Interaction of risk by condition by trial for mean rating on the "Urgent" and "Grating" scales.

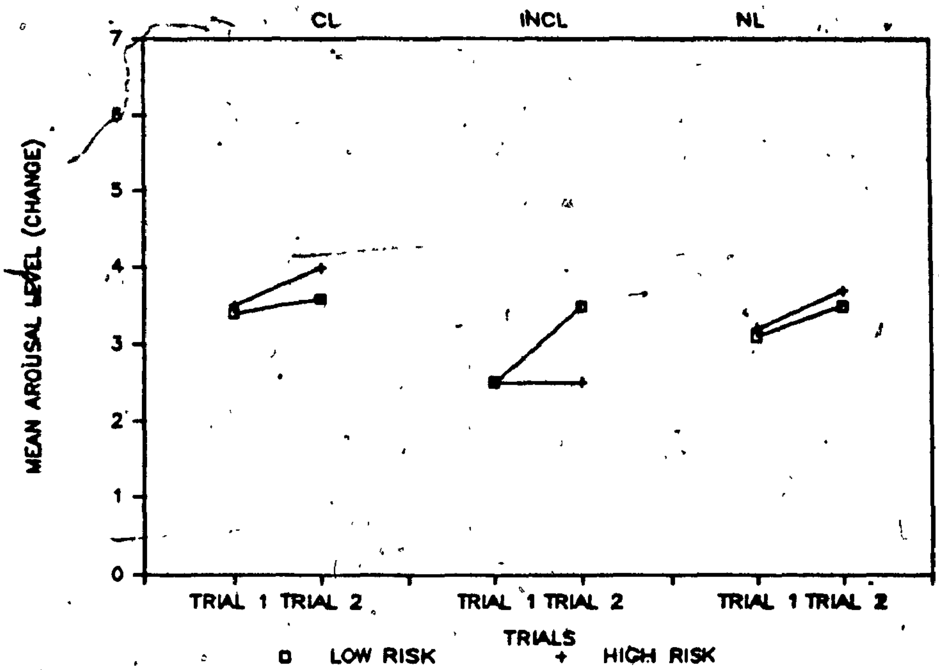
scales, significant differences between trials were found only for the high-risk cries in the correct labeling condition ($p < .01$ in each case). Finally, significant differences were found between trials only for the low-risk cries in the incorrect labeling condition on the scale: Distressing ($p < .05$).

Other effects revealed from the analyses on the rating scales included a vocalization x trial interaction, $F(1,42) = 6.44$, $p < .01$, that qualified the main effect of trial on the "Urgent" scale. The interaction reflected the fact that while preterm and fullterm cries were rated equally "urgent" on trial 1, fullterm cries elicited more "urgent" ratings on trial 2. The main effect of condition on the "Arousal" scale was also qualified by a vocalization x condition interaction, $F(2,42) = 3.62$, $p < .03$. Scheffé tests indicated that subjects given the incorrect label rated preterm cries as less arousing than subjects in both the correct and no label conditions ($p < .01$), and the fullterm cries as less arousing than subjects given the correct label ($p < .01$). Subjects in the correct and no label conditions did not differ in their ratings of the cries. Finally, the analysis of the "Piercing scale" also revealed a significant vocalization x group interaction, $F(1,42) = 4.33$, $p < .04$, a significant vocalization x group x condition interaction, $F(2,42) = 3.24$, $p < .05$, and a significant vocalization x risk x group x condition interaction, $F(2,42) = 4.02$, $p < .02$. These effects reflected a difference between mothers' and nonmothers' in the correct labeling condition ratings of the high-risk preterm cries, a difference between mothers' and nonmothers' in the incorrect labeling condition ratings of the low-risk fullterm cries, as well as a difference between mothers' and nonmothers' in the no labeling condition ratings of the fullterm high-risk cries. Scheffé tests revealed that for the correct labeling condition, nonmothers rated the high-risk preterm cries as significantly more piercing than did mothers; mothers, on the other hand, rated the fullterm high-risk cries as significantly more piercing than preterm high-risk cries ($p < .01$ in each case). For the incorrect labeling condition, mothers rated the low-risk fullterm cries significantly more piercing than nonmothers did, while for the no labeling condition nonmothers rated the high-risk fullterm cries significantly more piercing than did mothers ($p < .01$ in each case).

Caregiving Choices. Separate analyses of variance were performed on each dimension. The analysis of scores on the dimension "how immediately effective the response is at terminating the crying" revealed no main effects of infant experience group, condition, vocalization type, risk level, or trial. A significant vocalization x group interaction, $F(1,37) = 7.29$, $p < .01$ was found, reflecting the fact that while mothers chose caregiving responses for the preterms that they believed were significantly "more effective in terminating the crying" than responses they chose for the fullterms (Scheffé test: $p < .05$), nonmothers did not differ in their responses chosen for the fullterm and preterm cries. A significant vocalization x risk interaction, $F(1,37) = 4.08$, $p < .05$ was also revealed. Although visual inspection of the means indicated that of the four cry types, responses considered to be most effective in terminating the crying were selected for cries of the preterm high-risk infants, Scheffé tests yielded no significant differences in "effectiveness" among responses for the cries. Finally, a risk x trial x group interaction, $F(1,37) = 5.07$, $p < .03$ was found. The interaction was attributed to the fact that while nonmothers did not differ in their responses made to the two risk types on both trials, mothers did not differ in their responses on trial 1 but chose responses for the low-risk cries on trial 2 that they considered more "effective" than the ones they selected on trial 1 ($p < .05$).

The analysis of variance of scores on the dimension "how tender and caring the response is," revealed no main effects of infant experience group, condition, vocalization type, or risk level, but a main effect of trial, $F(1,37) = 9.42$, $p < .004$, which was qualified by a vocalization x trial interaction, $F(1,37) = 6.92$, $p < .01$. The interaction reflected the fact that preterm and fullterm cries elicited responses on trial 1 that were considered equally moderately "tender and caring," and these responses did not change for preterm cries on trial 2, while fullterm cries elicited responses on trial 2 that were considered more "tender and caring" than trial 1 responses (Scheffé test: $p < .01$). The analysis also yielded a significant vocalization x group interaction, $F(1,37) = 9.77$, $p < .003$, a significant vocalization x risk interaction, $F(1,37) = 12.49$, $p < .001$, as well as a significant vocalization x risk x group interaction, $F(1,37) = 5.12$, $p < .03$. These effects are attributed to the fact that mothers, overall, selected responses for preterm high-risk infants that they considered more "tender and caring" than responses they chose for each of the other three cry types (Scheffé tests: $p < .01$ for each comparison); nonmothers did not differ in their responses as a function of risk type, but chose more tender and caring responses for fullterm cries than for preterm cries ($p < .05$).

Subjective Arousal Level. The analysis of variance of subjective arousal level was conducted on change scores computed separately for trial 1 and for trial 2. The analysis revealed no main effects of infant experience group, condition, vocalization type, or risk level, but a main effect of trial, $F(1,40) = 12.80$, $p < .001$, reflecting the fact that arousal levels increased over trials. A significant risk x condition interaction, $F(2,40) = 3.18$, $p < .05$ was revealed, which was qualified by a significant risk x trial x condition interaction, $F(2,40) = 6.28$, $p < .004$. The 3-way interaction, which is displayed in Figure 7, is attributed to a different pattern of response across trials for the three treatment conditions. In the no label condition, the low- and high-risk cries induced similar levels of arousal on trial 1, and on trial 2, they both induced increased arousal levels (a significant increase was found across trials for the high-risk cries, and a marginally significant increase for the low-risk cries). For both labeling conditions, however, cries of the two risk types induced similar levels of arousal on trial 1, but on trial 2, only cries of a particular risk type induced increased arousal levels in each of the labeling conditions. For the correct labeling condition, there was only a negligible change across trials for the low-risk cries, while the high-risk cries significantly induced increased arousal levels on trial 2 (Scheffé test: $p < .05$). The converse occurred in the incorrect labeling condition. High-risk cries induced no change in arousal levels from trial 1 to trial 2, while the low-risk cries induced significant increases in arousal levels from trial 1 to trial 2 ($p < .01$).



CL = Correct Label
INCL = Incorrect Label
NL = No Label

Figure 7. Trial 1 and 2: Interaction of risk by condition by trial for mean arousal level (change).

Psychophysiological Measure

Heart Rate. The analysis of variance of heart rate was also conducted on change scores computed separately for trial 1 and for trial 2. Appendix O contains the ANOVA source table. The analysis yielded no main effects of infant experience group, condition, risk level, or trials. Significant main effects, however, were found for vocalization type, $F(1,41) = 4.36$, $p < .04$, and for seconds, $F(9,369 = 8.83$, $p < .00001$, and both effects were qualified by interactions. The effect of seconds was qualified by a significant trial x seconds interaction, $F(9,369) = 1.89$, $p < .05$, and a significant trial x seconds x group interaction, $F(9,369) = 2.18$, $p < .02$). As Figure 8 demonstrates, these effects are attributed to the fact that the differences that were present on trial 1 in mothers' and nonmothers' response patterns to the onset of the cries (first 2 to 5 s), were no longer present on trial 2. The effect of vocalization was qualified by a vocalization x trials x seconds interaction, $F(9,369) = 2.02$, $p < .04$ (see Figure 9), reflecting the fact that preterm and fullterm cries elicited different response patterns over the first 3 s on trial 1, and that these patterns were essentially reversed over the first 3 s on trial 2. Preterm cries elicited an increase over the first 3 s on trial 1, and a decrease over this same period on trial 2. Fullterm cries, in contrast, elicited a decrease over the first 3 s on

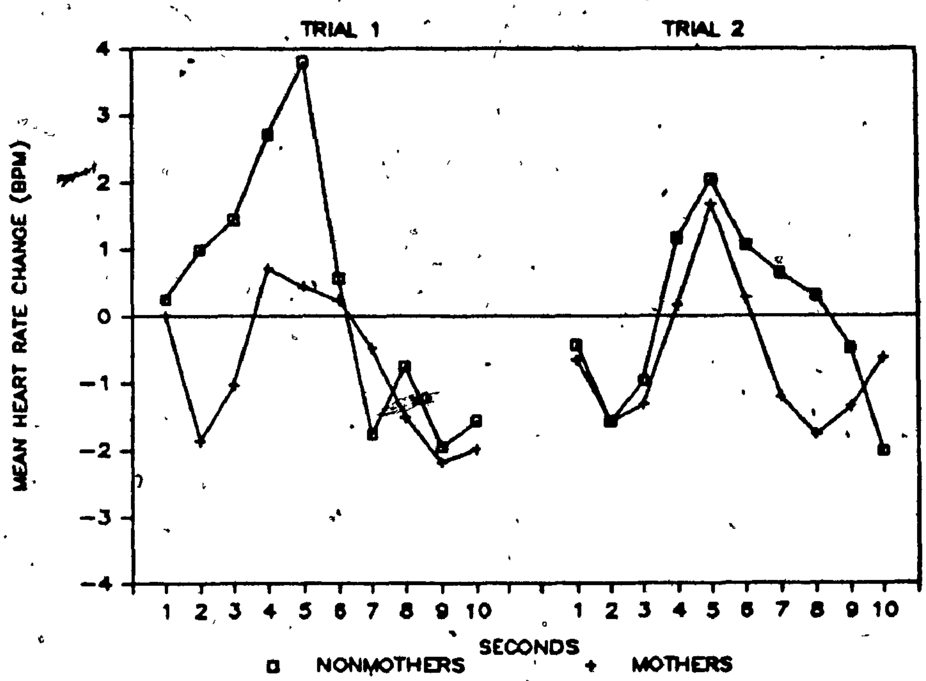


Figure 8. Trial 1 and 2: Interaction of group by trial by seconds for mean heart rate change (BPM).

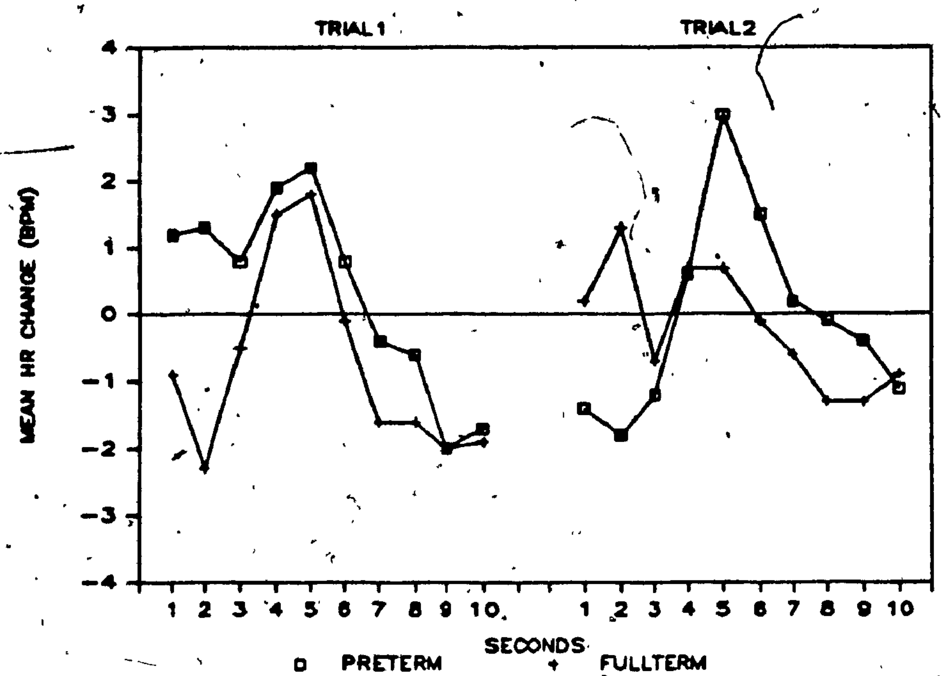


Figure 9. Trial 1 and 2: Interaction of vocalization by trial by seconds for mean heart rate change (BPM).

trial 1, and an increase over this period on trial 2.

Finally, clearer effects of labeling were revealed in a significant 4-way -- risk x condition x group x seconds interaction, $\underline{F}(18,369) = 1.93$, $\underline{p} < .01$, as well as a significant 5-way -- vocalization x risk x trial x group x condition interaction, $\underline{F}(2,41) = 3.56$, $\underline{p} < .04$. Because the trial factor did not interact with the risk x group x condition x seconds interaction, this interaction was difficult to interpret. However, a comparison (see Figure 10 for nonmothers only) of the marginally significant 3-way interaction of risk x group x seconds, previously found on the analysis of the heart rate scores for trial 1 only, to the present risk x group x condition x seconds interaction, allowed for an interpretation of the latter. The comparison essentially revealed that the patterns of response exhibited to the low- and high-risk cries by mothers and by nonmothers in the incorrect label subgroups, were most dissimilar to the mothers' overall, and to the nonmothers' overall pattern exhibited on trial 1 (prior to labeling). Like the nonmothers' overall response pattern on trial 1, the characteristic response pattern exhibited by the correct and the no label nonmothers' subgroups (except for fluctuations at the onset) to the high-risk cries, and to the low-risk cries was cardiac acceleration; while the incorrect label subgroup, however, displayed primarily cardiac acceleration to the high-risk

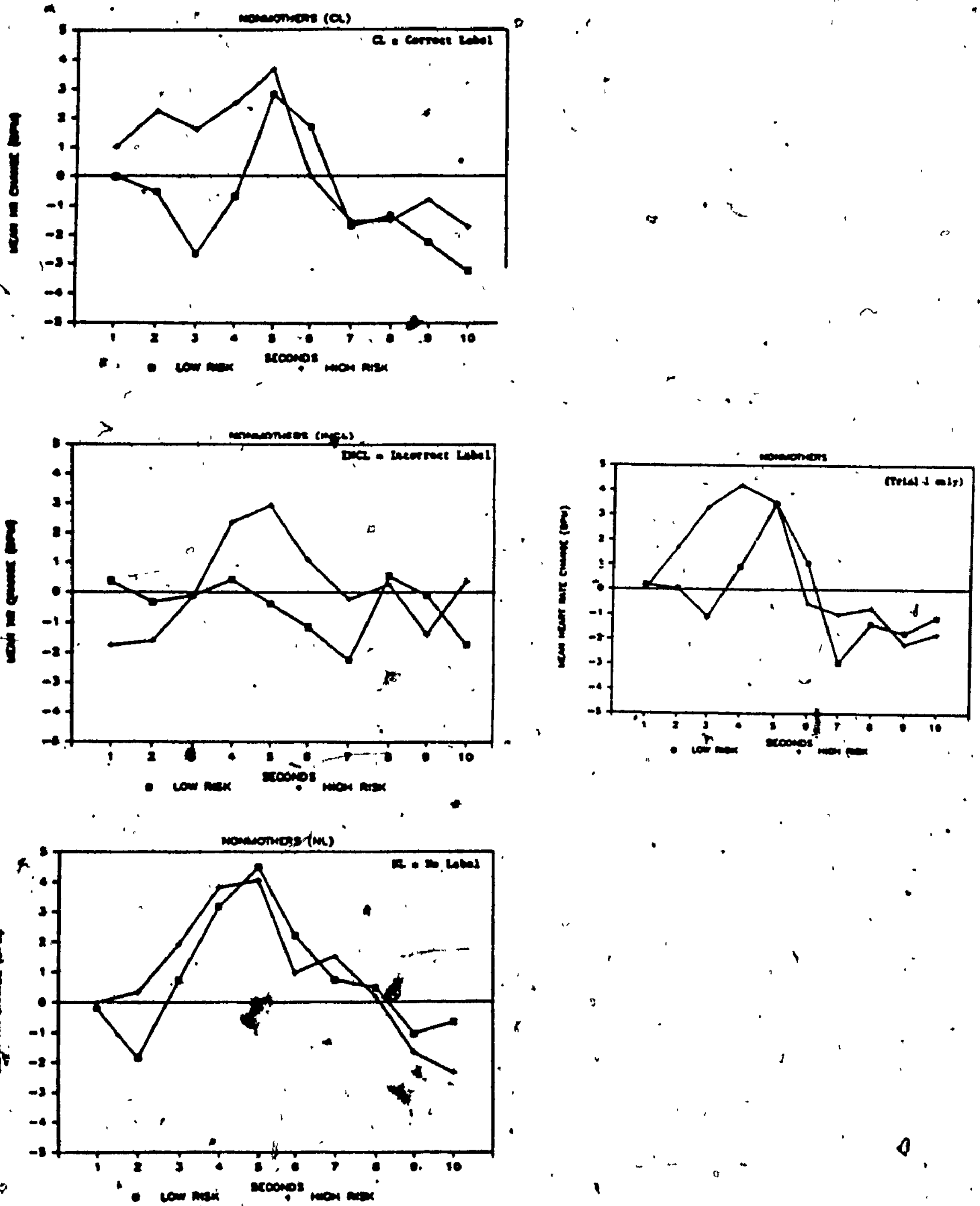


Figure 10. Trial 1 and 2: Interaction of risk by group by condition by seconds for mean heart rate change (BPM) (shown for nonmothers only).

cries, it evidenced deceleration to the low-risk cries. Similarly, except for fluctuations at the onset, the correct and no label mothers' groups, like mothers overall on trial 1, exhibited mainly deceleration to the low-risk cries, and acceleration to the high-risk cries. For the incorrect label mothers' subgroup, however, cardiac deceleration remained the characteristic pattern to low-risk cries, and as well, the high-risk cries now elicited a definite general sustained suppression of heart rate levels.

An examination of the 5-way interaction of vocalization x risk x trial x condition x group confirmed that for the respective infant experience groups (mothers/nonmothers), the correct and no label subgroups were evidencing similar changes in level and direction of heart rate across trials to the different cries, in contrast to the two incorrect label subgroups. It also emerged, however, that the level and direction of heart rate change elicited by the different cries in the three nonmothers' subgroups were not comparable on trial 1, neither were the changes elicited in the mothers' subgroups. Consequently, to eliminate this confounding effect, and to clarify the nature of the change that occurred across the groups, a further analysis was conducted on heart rate, on change scores computed by subtracting trial 1 scores from trial 2 scores. The analysis revealed a significant vocalization x risk x group x condition interaction, $F(2,41) = 3.56$, $p < .04$. The interaction, which is displayed in Figure 11, is attributed to the fact that while the direction of change and level of heart rate (except for nonsignificant fluctuations) elicited by the different vocalizations were essentially the same for the correct and the no label mothers' subgroups, and as well this relationship holds for the correct and no label nonmothers' subgroups, the two incorrect label subgroups differ markedly from their respective groups in terms of the direction of change elicited by the different cries. For both the correct and the no label nonmothers' subgroups the most marked change was a decrease in general level of heart rate elicited by the high-risk preterm cries from trial 1 to trial 2; for the incorrect label subgroup high-risk preterm cries also elicited the most marked change, but in contrast to the other two subgroups, the change elicited from trial 1 to trial 2 was an increase in level of heart rate. In contrast to nonmothers, for the correct and the no label mothers' subgroups, the most marked change occurred to the low-risk fullterm cries, which was characterized by an increase in level of heart rate from trial 1 to trial 2; for the incorrect label subgroup, however, a marked decrease in level of heart rate from trial 1 to trial 2 was elicited by the high-risk preterm cries.

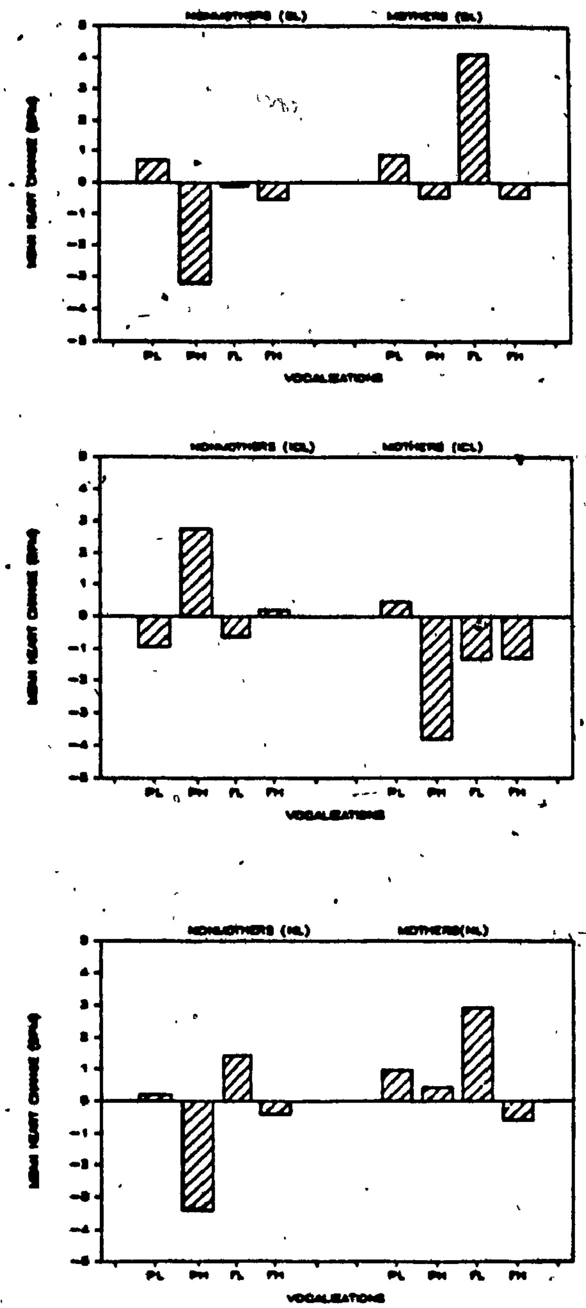


Figure 11. Trial 1 and 2: Interaction of vocalization by risk by group by condition for mean heart rate change (BPM).

Discussion

Meaningful differences among the cry types did not emerge on the Zeskind and Lester scales or the arousal level measure, but only on the Zeskind Caregiving response measure. Thus, despite the absence of coos, neither the Zeskind and Lester scales nor the arousal level measure were sufficiently sensitive to differentiate the spontaneous cries of high- and low-risk preterm and fullterm infants. This finding failed to support the hypothesis that high-risk preterm cries, in the absence of coos, would be rated more negatively, and induce more feelings of arousal than the low-risk preterm and the low-risk fullterm cries. However, on the Zeskind Caregiving measure, the high-risk preterm cries did elicit caregiving responses considered to be more "effective in terminating the crying," and as well as caregiving responses that were considered more "tender and caring" than the responses elicited by the low-risk preterm cries. This latter finding provides partial support for the predicted differences among cries, as well as the notion that the presence of coos in Experiment 1 served to mask the effects among cries.

On the other hand, the major effect of maternal experience seen in heart rate change to the high-risk preterm cries in Experiment 1 was not replicated. Instead, heart rate revealed only a trend reflecting a different response pattern for mothers and nonmothers to preterm and fullterm cries. In addition, there was a trend for a different response pattern for mothers and nonmothers elicited by the high- and low-risk cries. While nonmothers evidenced primarily marked cardiac acceleration to both preterm and fullterm cries, as well as marked cardiac acceleration to both the low- and high-risk cries, mothers appeared to respond sensitively to both the gestation and risk status of the infants. Mothers responded to preterm cries, as well as to cries of the high-risk infants with cardiac acceleration, and to the fullterm cries and cries of low-risk infants with cardiac deceleration.

Mothers, on the other hand, never attained the levels of cardiac acceleration nonmothers did. In contrast, the mothers' pattern of cardiac deceleration was much more marked than their acceleratory pattern which accounts for why the mothers' overall response pattern to the cries was primarily deceleration. The finding, however, that mothers made more "tender and caring" responses to preterms than to fullterms, as well as the trend seen for mothers to choose responses that they considered more "effective" in terminating the preterm cries, and the high-risk cries, concur with the heart rate findings.

The congruence of the heart rate and the caregiving data suggest that maternal experience may provide a special sensitivity to cries. Both heart rate and caregiving responses seem to reflect this differential sensitivity, which is also consistent with the findings of Experiment 1. However, it is not clear why mothers in the present study were sensitive to the high-risk cries in general, while mothers in the previous study evidenced a special sensitivity only to the preterm high-risk cries. One possible explanation of the discrepant findings is that coos interacted with and overshadowed the heart rate response to other vocalizations. Conceivably, only the most potent stimuli would elicit a response in such circumstances.

Nevertheless, the pattern of responding exhibited by mothers and nonmothers in the present study differ markedly from the pattern seen in Experiment 1. Mothers in Experiment 1 exhibited marked cardiac acceleration, while only slight to moderate levels of cardiac acceleration were attained in Experiment 2. Nonmothers in Experiment 1 evidenced a slow, and only slight to moderate level of cardiac acceleration, while the level of cardiac acceleration attained in this Experiment was much more rapid and markedly higher. These findings invite speculations about what factors may be contributing to these differences.

First, in comparing the two studies there are appreciable differences in subject characteristics, particularly in the mothers' group. Only mothers of fullterm infants were investigated in the present study. In addition, these mothers were caring for infants that were appreciably younger than the infants of mothers in Experiment 1. Presumably, infants of mothers in the present investigation were still exhibiting frequent crying behavior. These factors together may have tempered the mothers' cardiac reactivity pattern. Specifically, although mothers appear to be sensitive to characteristics of cries that convey information about the risk status of infants unfamiliar to them, the nature of the mothers' own immediate caregiving experience appear to interact with, and modify the intensity of their response.

The nonmothers' marked acceleratory pattern, on the other hand, may well be explained in terms of the absence of the coos. With respect to subject characteristics, there are no obvious differences between the nonmothers' groups of Experiments 1 and 2. Consequently, rather than subject differences, it is possible the absence of coos may have served to make the cry stimuli, in general, more salient for nonmothers. This interpretation of the nonmothers' heart rate response seems plausible in light of the effect the absence of the coos had on the mothers' response.

The finding that both mothers and nonmothers exhibit cardiac acceleration is not entirely surprising, and has implications with regard to the significance of cardiac acceleration. As in Experiment 1 in the Bryan et al. (1984) study, nonmothers were seen to evidence a pattern of cardiac acceleration, but only during the first presentation of the vocalization types. The response subsequently habituated when reactivity over all vocalizations was averaged. Given that this acceleratory pattern exhibited by nonmothers has been replicated over three studies, it is most unlikely that this is only a spurious finding. Rather, it appears that cardiac acceleration is a nonspecific spontaneous physiological response elicited in women with and without infant caregiving experience by infant cries. This interpretation is based on the fact that in the present experiment, as well as in Experiment 1, the Caregiving responses showed that mothers and nonmothers differed appreciably on their covert intentions to administer to the infants, but at the same time nonmothers, like mothers, were seen to exhibit cardiac acceleration. Moreover, in a recent study (Boukydis & Burgess, 1982), nonmothers showed a similar dissociation between their self reports and their autonomic reactivity indexed by skin potential increases. Whether the autonomic reactivity pattern women exhibit is a purely biological response, or a learned response -- transmitted through cultural values, is a question beyond the scope of the present research. However, based on the congruence between the mothers' heart rate and subjective responses, it is clear that at some point this possible subcortical physiological response becomes modified by cognitions.

The role of cognitions in the heart rate response to cries was clearly established by the labeling manipulation, although few of the specific predictions were supported. Marked effects of labeling were revealed on the Zeskind and Lester scales, and the arousal level measure; no relationship was evident, however, between the effects seen on these measures and cardiac responses. The fact that both the Zeskind and Lester scales, and the arousal level measures consistently failed to differentiate among the cry types, coupled with the ease witn which the subjects' responses on these measures were manipulated, suggest that subjects were responding on both measures to the demand characteristics of the situation. Nevertheless, systematic changes occurred in the heart rate response. Cardiac acceleration was effectively induced in nonmothers in response to the high-risk preterm infants labeled "healthy fullterm," while in response to these same stimuli, cardiac deceleration was effectively induced in mothers. Thus, although the heart rate changes seen were not in the expected direction, and in addition, although no explanation can be offered for why mothers, in contrast to nonmothers, appeared particularly "susceptible" to suggestion, the effects of the cognitive set established in subjects through labeling were evident.

In conclusion, the single most important finding from Experiment 2 was the nonspecificity of cardiac acceleration to cries. Granted, mothers appeared to be particularly sensitive to the preterm cries, as well as to high-risk cries, in general, since these cries elicited caregiving responses which were perceived as "tender and loving," and "immediately effective in terminating the crying." It is questionable, however, whether the cardiac acceleration these cries elicited conveyed any special or unique meaning. Rather, the absence of cardiac acceleration in the mothers' response to fullterm cries, may simply reflect the mothers' superior cognitive ability to differentiate between cries. Thus, while heart rate may be a sensitive discriminatory measure, it may not be a useful index of maternal response to cries to the extent that cardiac acceleration is relied upon to index maternal behavioral states.

Finally, the research undertaken was not a direct test of either Graham and Clifton's (1966) or Obrist's (1978) model of cardiac functioning. Analysis of the significance of cardiac acceleration in the context of either model is outside the scope of this research. Nevertheless, the present findings do have some implication with regard to the appropriateness of these models. The present research adopted a systematic empirical approach, the findings of which have, at least, shed some light on the nature and modifiability of cardiac reactivity. Whether it would be productive to persist in the attempt to adapt traditional psychophysiological models to interpret reactivity to infant affective stimuli is questionable. Such attempts, so far, do not appear to have improved our understanding of the basic issues. In contrast, empirical analyses, perhaps focusing upon the origin of the adult reactivity, may be a more fruitful approach.

General Discussion

Experiment 1 examined how the level of neonatal medical risk in preterm and fullterm infants influenced psychophysiological and subjective reactivity. Specifically, Experiment 1 investigated the impact of the spontaneous cries of high- and low-risk preterm and fullterm infants, as well as control coos, on mothers and nonmothers. No relation was established between level of neonatal medical risk and perceived aversiveness of either preterm or fullterm cries, as assessed by the Zeskind and Lester scales, the Zeskind Caregiving choices, and the arousal level measure. Preterm cries, in general, however, were rated as more urgent than fullterm cries. In addition, mothers also differentiated between preterm and fullterm cries in terms of the caregiving responses the two cry types elicited. Mothers, in contrast to nonmothers, chose responses for the preterm cries that they considered most "tender and loving." These findings, together, support the notion that there are perceived differences in preterm and fullterm cries, and that maternal experience results in a special sensitivity to these differences.

A more major effect of maternal experience was found on the heart rate measure. Both mothers and nonmothers differentiated between the cries of low- and high-risk preterm infants. Mothers, however, were found to be more sensitive than nonmothers to cry characteristics that convey information about risk status, since they responded to the onset of the high-risk preterm cries with cardiac acceleration. Thus, the heart rate finding from Experiment 1 was consistent with other reports in the literature that maternal experience results in a special sensitivity to infant cry characteristics. Moreover, the findings from this experiment showed that cardiac acceleration is not a unique response elicited by one's own infant cry. However, the mothers' cardiac reactivity observed in Experiment 2 was much less intense than that seen in Experiment 1. This tempering of the mothers' response was attributed to their own immediate caregiving experience, in particular, the exposure to their own infants' frequent crying behavior. Wiesenfeld and Malatesta (1982) previously argued that given the evolutionary significance of the attachment between a mother and her infant, a mother's response to her own and an unfamiliar infant's crying should differ in intensity and pattern. The present research did not attempt to test this hypothesis. A certain plasticity was characteristic, however, of the response of mothers in Experiment 2 whose infants were presumably still interacting via the primary attachment behavior -- crying. Thus, it is possible that for mothers of young infants, their cardiac reactivity when faced with their "own" and "unfamiliar" cries, varies not in pattern but in intensity.

The findings from Experiment 1 did not clarify the significance of cardiac acceleration. Although congruence between the subjective and physiological responses elicited by the control coos was evident, a similar relationship was not established for the cry types. Consequently, in the absence of a relationship between the physiological responses and self reports elicited by cries, an interpretation of the physiological response seems questionable.

Experiment 2, therefore, attempted not only to replicate the major effect of maternal experience seen on the heart rate response to high-risk preterm cries, but also investigated in a more systematic manner the significance of cardiac acceleration in response to cries. Specifically, the role cognitive factors play in the cardiac response to cries was investigated by providing subjects with a particular cognitive set established through labeling. Coos were not included as stimuli in the investigation, since one possibility that was explored in Experiment 2 was that the presence of coos in Experiment 1 served to mask the effects among cries. In addition, more stringent criteria were adopted with respect to the selection of the sample of mothers that participated in Experiment 2.

Again, despite the absence of coos, differences among cries did not emerge on the Zeskind and Lester scales, or the arousal level measure. Moreover, the effect previously seen where preterm cries were rated as more "urgent" than fullterm cries was not replicated. Consistent with Experiment 1, however, the Zeskind Caregiving choices and heart rate were again found to be sensitive in differentiating among the cries.

Overall, the caregiving responses revealed that cries of the high-risk preterm infants tended to elicit the most "immediately effective responses in terminating the crying," as well as the most "tender and caring" responses. Moreover, the effect previously seen in Experiment 1, that mothers responded to the preterm cries with "tender and caring" responses was replicated. There was a trend that mothers made responses to the preterm cries, and to high-risk cries that they considered more "immediately effective in terminating the crying."

Experiment 2, on the other hand, did not replicate the major effect of maternal experience seen in response to the high-risk preterm cries. However, what emerged was a congruent pattern between the mothers' caregiving responses and their heart rate patterns. Although mothers' overall response pattern was characterized by cardiac deceleration, consistent with their caregiving responses was a trend for preterm cries, as well as cries of the high-risk infants to elicit cardiac acceleration. Thus, while the specific effect seen in response to the high-risk preterm cries in Experiment 1 was not replicated, both Experiments 1 and 2 have consistently revealed that mothers are particularly sensitive to infant cry characteristics.

Certain limitations were evident in the findings. None of the effects observed in mothers were particularly robust. Not only was the major effect of maternal experience seen in Experiment 1 not replicated, but several of the effects seen in Experiment 2, on both the heart rate and the caregiving response measures, emerged only as trends. Other measures, like the Zeskind and Lester scales, and the arousal level measure showed no meaningful effects in either experiment. However, procedural details may account for these findings.

First, in Experiment 1, it was argued that coos may have masked the effect among cries. Experiment 2 revealed that this was true to a certain extent. The fact that mothers in Experiment 2, in contrast to Experiment 1, responded to the gestation and the risk status of infants separately, is not surprising given other recent reports in the literature, and suggest coos masked the emergence of this effect in Experiment 1.

Second, as pointed out in the discussion of the findings of Experiment 2, the nature of the mothers' own immediate caregiving experience seems to be a viable explanation for the marked differences observed between Experiments 1 and 2 in terms of the intensity of the mothers' cardiac reactivity patterns.

Third, the failure to establish a strong link between medical risk and perceived aversiveness of either preterm or fullterm cries in both Experiments 1 and 2 is in direct conflict with several reports in the literature (e.g., Friedman et al., 1982; Zeskind & Lester, 1978). One major difference between the studies cited and the present investigation is the type of cry investigated. Rather than investigating the pain cry, which the cited studies have employed, the present investigation focused on the spontaneous cry. The failure to establish a relation between medical risk and the perceived aversiveness of the spontaneous cries of preterm and fullterm infants was interpreted elsewhere in this thesis to reflect the fact that in contrast to the pain cry, characteristics about risk may be manifested only in a subtle way in the spontaneous cry. Consequently, more fine grained measures may be required to detect the subtle differences among the spontaneous cries of infants. Nevertheless, the findings, overall, suggest that caution should be exercised when predicting from responses elicited by an infant pain cry to those responses elicited by the spontaneous cry.

Zeskind and Huntington (1984) in a recent study reported that responses to cries varied as a function of methodological context. The findings of the present research have found support for Zeskind and Huntington's contention. Simultaneous presentation of infant affective stimuli, maternal characteristics, and the use of naturally occurring vocalizations were all implicated as factors which tempered the findings of the present research.

To continue with methodological issues, in the absence of coos, nonmothers showed heart rate increase in response to all cries. This finding underscores the inclusion of an appropriate comparison group in order to more fully comprehend the significance of heart rate change. It is on the basis of such comparison that the present research questions the validity of cardiac acceleration as a sensitive index of maternal response to cries. In the absence of the nonmothers group, the mothers' cardiac response might have been interpreted, inappropriately, as "special." Rather, the explanation offered here is that in response to cries, cardiac acceleration may be a <u>nonspecific</u> physiological response, but that cognitions interact with and modify this response. The congruence between the mothers' caregiving and physiological responses, and in addition, the effect of the cognitive set seen on the heart rate response underlines the role of cognitive factors in reactivity to the cries.

In conclusion, there may be differences between the spontaneous cries of preterm and fullterm infants, as well as between the cries of infants of high- and low-medical risk. Moreover, mothers appear to be particularly sensitive to these differences both in terms of their caregiving and heart rate responses. Future research that include the caregiving responses might be useful, since it is not known how these "covert" intentions would be translated into actual overt behavior. On the other hand, other than an index of a difference, cardiac reactivity patterns may not contribute much to the understanding of maternal response to cries.

Cardiac acceleration to infant cries, since it may translate to a "readiness" to respond, may be adaptive for the species. However, persistent cardiac hyperreactivity exhibited by a mother (e.g., mothers of preterm infants) to her infant's crying could conceivably be personally maladaptive, in terms of overtaxing the mother's cardiovascular system. Moreover, because of the mother's association of her infant's crying with a persistent heightened state of arousal, one possibility is that the mother may come to view her infant as aversive. Thus, since mothers were seen to be highly susceptible to "suggestions" in the present research, an important implication of the findings is that instructions may be an effective tool for modifying cardiac reactivity.

References

Ainsworth, M. D. S. (1969). Object relations, dependency, and attachment: A theoretical view of the mother-infant relationship. Child Development, 40, 969-1025.

Ainsworth, M. D. S. (1972). Attachment and dependency: A comparison. In J. Gewirtz (Ed.), Attachment and dependency. Washington, DC.: Winston.

Bleichfeld, B., & Moley, B. E. (1984). Psychophysiological responses to an infant cry: Comparison of groups of women in different phases of the maternal cycle. Developmental Psychology, 20, 1082-1091.

Boukydis, C. F. Z., & Burgess, L. B. (1982). Adult psychophysiological response to infant cries: Effects of temperament of infant, parental status, and gender. Child Development, 53, 1291-1298.

Bowlby, J. (1969). Attachment and loss: Vol. 1. Attachment. New York: Basic Books.

Bryan, Y. E., Taylor, N., & Seraganian, P. (1984). Mothers' and nonmothers' responses to infant coos and cries: Perceived characteristics and psychophysiological response patterns. Unpublished manuscript, Concordia University, Montreal, Quebec.

Donovan, W. L., & Leavitt, L. A. (1984). Effects of experimentally manipulated attributions of infant cries on maternal learned helplessness. Paper of poster presented at the Fourth International Conference on

Infant Studies, New York, New York.

Donovan, W. L., Leavitt, L. A., & Balling, J. D. (1978). Maternal physiological response to infant signals. Psychophysiology, 15, 68-74.

Feldman, S. S., & Nash, S. C. (1978). Interest in babies during young adulthood. Child Development, 49, 617-622.

Friedman, S. L., Zahn-Waxler, C., & Radke-Yarrow, H. (1982). Perceptions of cries of fullterm and preterm infants. Infant Behavior and Development, 5, 161-173.

Frodi, A. M., & Lamb, M. E. (1978). Sex differences in responsiveness to infants: A developmental study of psychophysiological and behavioral responses. Child Development, 49, 1182-1188.

Frodi, A. M., & Lamb, M. E. (1980). Child abusers' responses to infant cries and smiles. Child Development, 51, 238-241.

Frodi, A. M., Lamb, M. E., Leavitt, L. A., & Donovan, W. L. (1978a). Fathers' and mothers' responses to infant cries and smiles. Infant Behavior and Development, 1, 187-198.

Frodi, A. M., Lamb, M. E., Leavitt, L. A., Donovan, W. L., Neff, C., & Sherry, D. (1978b). Fathers' and mothers' responses to the faces and cries of normal and premature infants. Developmental Psychology, 14, 490-498.

Frodi, A. M., Lamb, M. E., & Wille, D. (1981). Mothers' responses to cries of normal and premature infants as a function of birth status of their own child. Journal of Research in Personality, 15, 122-133.

Graham, F. K., & Clifton, R. K. (1966). Heart rate change as a component of the orienting response. Psychological Bulletin, 65, 305-320.

Hare, R. (1973). Orienting and defensive responses to visual stimuli. Psychophysiology, 10, 453-464.

Lamb, M. E. (1978). Influence of the child on marital quality and family interaction during the prenatal, perinatal, and infancy periods. In R. M. Lerner & G. B. Spanier (Eds.), Child influences on marital and family interaction: A life span perspective. New York: Academic Press.

Lounsbury, M. L., & Bates, J. E. (1982). The cries of infants of differing levels of perceived temperamental difficultness: Acoustic properties and effects on listeners. Child Development, 53, 677-686.

Murray, A. (1979). Infant crying as an elicitor of parental behavior: An examination of two models. Psychological Bulletin, 86, 191-215.

Obrist, P. A. (1976). The cardiovascular-behavioral interactions -- as it appears today. Psychophysiology, 13, 95-107.

Parke, R., & Collmer, C. (1975). Child abuse: An interdisciplinary review. In E. M. Hetherington (Ed.), Review of child development research (Vol. 5).

Chicago: University of Chicago Press.

Parmelee, A. H., Kopp, C. B., & Sigman, M. (1976). Selection of developmental assessment techniques for infants at risk. Merrill-Palmer Quarterly, 22, 177-199.

Prechtl, H. F. (1968). Neurological findings in newborn infants after pre- and perinatal complications. In J. Jonix, H. Visser, & J. Troelstra (Eds.), Aspects of prematurity and dismaturity. Leiden: Stenfert-Kroese.

Sagi, A. (1981). Mothers' and nonmothers' identification of infant cries. Infant Behavior and Development, 4, 37-40.

Sinyor, D., Schwartz, S., Peronnet, F., Brisson, G., & Seraganian, P. (1982). Aerobic fitness level and reactivity to psychosocial stress: Physiological, biochemical, and subjective measures. Psychosomatic Medicine, 45, 205-217.

Wasz-Hockert, O., Partanen, T., Vuorenkoski, V., Michelsson, K., & Valanne, E. (1964). Effect of training on ability to identify preverbal vocalizations. Developmental Medicine and Child Neurology, 6, 397-402.

Wiesenfeld, A. R., & Klorman, R. (1978). The mothers' reactions to contrasting affective expressions by her own and an unfamiliar infant. Developmental Psychology, 14, 294-304.

Wiesenfeld, A. R., & Malatesta, C. Z. (1982). Infant distress: Variables affecting responses of caregivers and others. In L. W. Hoffman, R. Gandelman, & H. R. Schiffman (Eds.), Parenting: Its causes and consequences. Hillsdale, NJ: Erlbaum.

Wiesenfeld, A. R., Malatestá, C. Z., & DeLoach, L. L. (1981). Differential parental response to familiar and unfamiliar infant distress signals. Infant Behavior and Development, 4, 281-295.

Zeskind, P. S. (1980). Adult responses to the cries of low and high risk infants. Infant Behavior and Development, 3, 167-177.

Zeskind, P. S. (1983). Perceptions of cries of low- and high-risk infants. Child Development, 54, 1119-1128.

Zeskind, P. S., & Huntington, L. (1984). The effects of within-group and between-group methodologies in the study of perceptions of infant crying. Child Development, 55, 1658-1665.

Zeskind, P. S., & Lester, B. M. (1978). Acoustic features and auditory perceptions of the cries of newborns with prenatal and perinatal complications. Child Development, 49, 580-589.

Appendix A

Characteristics and Obstetric Complications Found for Sample of Infants Providing Cries

Table A

Characteristics of Infants Providing Cry Samples

	Fullterms Complications		Preterms Complications	
	Low	High	Low	High
Number of Nonoptimal Obst. Conditions				
Mean	0.50	5.75	1.00	5.50
Gestational Age (Weeks)				
Mean	39.3	39.6	35.6	35.0
Range	39-40	39-40	34.5-36.4	33.5-36.5
Birthweight (Grams)				
Mean	3444	3715	2572	2481
Range	3061-3940	3260-4480	2154-2948	1980-3420
1-Min Apgar Score				
Mean	9	7.5	8.5	6.2
Range	9-9	7-8	8-9	4-8
5-Min Apgar Score				
Mean	9.8	9.2	9.8	8.5
N per Group	4	4	4	4

All infants were recorded while being weighed at a postnatal age of 3 days.

Table B

Obstetric Complications Found for Sample of Infants Providing Cries

Maternal Factors	
Age (30)	(5)[a]
Single Marital Status	(3)
Parity (6)	(1)
Infection in Pregnancy	(1)
Maternal Disease	(1)
Edema	(1)
Previous C-section	(1)
Cephalo-Pelvic Disproportion	(2)
Low Socio-Economic Status	(2)
Parturitional Factors	
Multiple Birth	(2)
Induced Delivery	(4)
Prolonged Labour	(1)
Rapid Labour and Delivery	(1)
Abnormal Presentation	(1)
Drugs (Other Than Local Ones)	(10)
Forceps	(2)
Artificial Membrane Rupture	(5)
Premature Membrane Rupture	(2)
Wrapped Cord	(2)
C-Section	(4)

[a]Number of Infants

Appendix B

Zeskind and Lester Rating Scales

THE VOCALIZATION WAS

	1	2	3	4	5	6	7	
URGENT								NOT URGENT
PLEASING								GRATING
SICK								HEALTHY
SOOTHING								AROUSING
PIERCING								NOT PIERCING
COMFORTING								DISCOMFORTING
AVERSIVE								NON-AVERSIVE
NOT DISTRESSING								DISTRESSING

Indicate what you would do for this infant. (Circle only one): (a) feed (b) cuddle (c) pick up (d) clean (e) give a pacifier (f) wait and see.

Appendix C

Dimensions for Ranking Caregiving Choices

INSTRUCTIONS: Rank from 1 to 6 the caregiving choices presented below in both the categories provided

Caregiving choices	Tender and loving category most (1) to least (6)	Immediately effective in terminating the cry category most (1) to least (6)
FEED		
CUDDLE		
PICK-UP		
CLEAN		
GIVE A PACIFIER		
WAIT AND SEE		

Appendix D

Subject Information Questionnairè

DATE ______________

NAME ______________

AGE ______________

ADDRESS ______________________________

____

____

PRESENT OCCUPATION ______________ FULL TIME ___ PART TIME ___

(Indicate by check mark the number of days per week on the average that you assume the major responsibilities for looking after your child when he is awake)

1 day ___ 2 days ___ 3 days ___ 4 days ___ 5 days ___ 6 days ___

7 days ___

LEVEL OF EDUCATION ATTAINED: (COMPLETED)

SECONDARY ____ COLLEGE ____ UNIVERSITY ____

(Indicate by check mark the appropriate one)

IF PARENT STATE NUMBER OF CHILDREN AND INDICATE AGES

____

____

____

____

____

IF NONPARENT STATE WHETHER OR NOT YOU HAVE LOOKED AFTER AN INFANT 0-2 YEARS FOR AS LONG AS 2 WEEKS

____

____

____

Appendix E

Taped Instructions for Experiment 1

Experiment 1: Taped Instructions

All instructions will be communicated to you over the headphones. You are going to hear vocalizations from six infants, that is, you will hear the cries of four infants, as well as the coos and babbles of two infants. Each vocalization you hear will be 30 s long, and each vocalization will be separated from the next by a 3-min period of silence. During this period of silence you will be asked to rate the sound you have just heard on eight different rating scales. This procedure will be repeated until you have heard and rated all six vocalizations on the eight rating scales. (Pause) Are there any questions?

In front of you is a panel of seven red lights which are turned on and off by the dial below your right hand. These lights will represent your level of arousal during the session, and before and after each of the six vocalizations you will be asked to indicate your level of arousal by turning the dial to the left or to the right. There will be a practice trial, and specific instructions will be given as to how to use this panel of lights, as well as the rating scales. Your blood pressure will be measured automatically before, during and after each vocalization. Please try to move as little as possible as this interferes with our readings. If at any time during the experiment you should become distressed for one reason or another, do not hesitate to inform the experimenter. We will terminate the experiment at any time upon your request. Do you have any questions? (Pause)

We will now have the practice trial where you will hear only the cries of two infants. We will, however, go through all the steps as we would once the experiment begins, so that you become familiar with the task.

The center light on the panel in front of you is now turned on. Turning the dial to the left or right turns on lights in either direction. Try it for a few seconds, finishing off by bringing it back to the center position. (Pause) Note the word "now" beneath this center light. Try to think of this center light as representing your level of arousal, tension, nervousness, or excitement right now. Use it as a reference point against which you will compare any changes during the session. If you feel slightly aroused you would turn on light number +1 or, if you feel very aroused you will turn on light number +3. On the other hand, if you feel slightly relaxed you would turn on light number -1, or light number -3 if you are very relaxed. (Pause) Please indicate your level of arousal now. (Pause) Your blood pressure will now be taken. (Pause) After each vocalization please rate the sound on the eight scales provided. To use a scale, circle the number that represents the degree to which you feel one of the adjectives applies to the sound that you have heard. If neither adjective is applicable, circle the number 4 which is the neutral point. On the scale, 1 or 7 means "definitely appropriate," 2 or 6 means "moderately appropriate," 3 or 5 "slightly appropriate." As an example let us discuss today's weather; on a scale of 1 to 7, 1 being "hot" and 7 being "cold," how would you rate today's weather? (Pause for response) Now, you will hear the first cry, please listen carefully and begin rating only after the sound has stopped. Remember there will be a 3-min period of silence following each cry, use the first minute to rate the sound you have just heard. (At the beginning of cry number 1 blood pressure monitor triggered) (After rating of sound number 1) Please indicate your level of arousal now by again turning the knob below your right hand. (Immediately after experimenter again triggers blood pressure reading) (Pause 3-min; after the first 2-min) Please indicate your level of arousal now. (Blood pressure triggered; at the end of 1 min cry number 2 presented etcetera) (2-min after cry number 2) If there are no questions there will now be a short rest period prior to commencing the experiment (5-min Pause).

Experiment Now Begins

The experiment will now begin; the center light on the panel in front of you is now turned on. Note the word "now" beneath the center light. Try to think of this center light as representing your level of arousal, tension, nervousness, or excitement right now. Use it as a reference point against which you will compare any changes during the session. If you feel slightly aroused you would turn on light number +1, or if you feel very aroused you would turn on light number +3. On the other hand, if you feel slightly relaxed you would turn on light number -1, or light number -3 if you are very relaxed. Remember, the center light in front of you is your reference point against which you will compare any changes in arousal during the session. (3-min period of silence preceding each cry; after 2 minutes) Please indicate your arousal level now, always finishing off by bringing it back to the center position. (Blood pressure triggered) (After another minute of silence presentation of the first vocalization at the beginning of which blood pressure again triggered).

Appendix F

Source Tables for Analyses of Variance of Vocalization Ratings (Experiment 1)

Table A

Analysis of Variance of Rating Scales as a Function of Maternal Experience, Type of Vocalization and Level of Risk

Scale	Source	SS	df	MS	F	p
Urgent	Groups (G)	.27	1	.27	.07	
	$Error_b$	86.03	21	4.10		
	Vocalization (V)	1.20	1	1.20	1.62	
	G x V	.04	1	.04	.06	
	Error	15.56	21	.74		
	Risk (R)	393.65	2	196.82	81.85	$<.00001$
	R x G	3.47	2	1.74	.72	
	Error	101.08	42	2.40		
	V x R	6.55	2	3.23	2.44	$<.1$
	V x R x G	5.36	2	2.68	2.00	
	Error	56.33	42	1.34		
Grating	Groups (G)	.00	1	.00	.00	
	$Error_b$	34.53	21	1.64		
	Vocalization (V)	.10	1	.10	.16	
	G x V	.44	1	.44	.75	
	Error	12.44	21	.59		
	Risk (R)	488.44	2	244.22	372.18	$<.00001$
	R x G	8.44	2	4.22	4.72	$<.01$
	Error	37.55	42	.89		
	V x R	5.64	2	2.82	3.80	$<.03$
	V x R x G	4.77	2	2.38	3.22	$<.05$
	Error	31.13	42	.74		

Table A (Continued)

Scale	Source	SS	df	MS	F	p
Sick	Groups (G)	10.15	1	10.15	1.72	
	$Error_b$	123.76	21	5.89		
	Vocalization (V)	.03	1	.03	.02	
	G x V	4.55	1	4.55	2.21	
	Error	43.27	21	2.06		
	Risk (R)	118.41	2	59.20	24.60	<.00001
	R x G	1.95	2	.10	.41	
	Error	101.09	42	2.41		
	V x R	7.73	2	3.86	2.29	
	V x R x G	2.16	2	1.01	.64	
	Error	70.79	42	1.68		
Arousing	Groups (G)	2.11	1	2.11	1.08	
	$Error_b$	4.05	21	1.95		
	Vocalization (V)	.21	1	.21	.53	
	G x V	1.34	1	1.34	3.44	
	Error	8.37	21	.40		
	Risk (R)	413.05	2	206.52	188.18	<.00001
	R x G	1.49	2	.74	.68	
	Error	46.09	42	1.10		
	V x R	1.88	2	.94	1.24	
	V x R x G	4.11	2	2.05	2.72	<.08
	Error	31.76	42	.76		

Table A (Continued)

Scale	Source	SS	df	MS	F	p
Piercing	Groups (G)	.98	1	.98	.20	
	$Error_b$	103.55	21	4.93		
	Vocalization (V)	.37	1	.37	.22	
	G x V	.08	1	.08	.05	
	Error	35.06	21	1.67		
	Risk (R)	314.63	2	157.32	61.38	<.00001
	R x G	1.85	2	.93	.36	
	Error	107.65	42	2.56		
	V x R	3.62	2	1.81	1.11	
	V x R x G	4.87	2	2.44	1.49	
	Error	68.55	42	1.63		
Discomforting	Groups (G)	.00	1	.00	.00	
	$Error_b$	36.62	21	1.74		
	Vocalization (V)	.62	1	.62	1.08	
	G x V	2.24	1	2.24	3.91	<.06
	Error	12.03	21	.57		
	Risk (R)	414.94	2	207.47	179.58	<.00001
	R x G	5.98	2	2.99	2.59	
	Error	48.52	42	1.15		
	V x R	5.92	2	2.96	3.99	<.03
	V x R x G	.73	2	.36	.49	
	Error	31.17	42	.74		

Table A (Continued)

Scale	Source	SS	df	MS	F	p
Aversive	Groups (G)	3.21	1	3.21	1.30	
	$Error_b$	51.94	21	2.45		
	Vocalization (V)	.46	1	.46	.33	
	G x V	.00	1	.00	.00	
	Error	29.53	21	1.41		
	Risk (R)	366.43	2	183.22	106.40	<.00001
	R x G	8.52	2	4.26	2.47	
	Error	72.32	42	1.72		
	V x R	3.28	2	1.64	.97	
	V x R x G	3.05	2	1.53	.90	
	Error	71.41	42	1.70		
Distressing	Groups (G)	3.54	1	3.54	1.10	
	$Error_b$	67.76	21	3.23		
	Vocalization (V)	.00	1	.00	.00	
	G x V	5.27	1	5.27	4.91	
	Error	22.55	21	1.07		
	Risk (R)	408.82	2	204.41	120.89	<.00001
	R x G	2.50	2	1.25	.74	
	Error	71.02	42	1.69		
	V x R	8.39	2	4.20	3.95	<.03
	V x R x G	1.55	2	.78	.73	
	Error	44.58	42	1.06		

Appendix G

Source Table for Analysis of Variance of Subjective Arousal Settings (Experiment 1)

Table A

Analysis of Variance of SAR as a Function of Maternal Experience, Type of Vocalization, Level of Risk, and Periods

Source	SS	df	MS	F	p
Groups (G)	.01	1	.01	.00	
$Error_b$	103.93	19	5.47		
Vocalization (V)	1.96	1	1.96	2.50	
V x G	.45	1	.45	.58	
$Error_1$	14.93	19	.78		
Risk (R)	91.03	2	45.52	72.97	<.00001
R x G	.24	2	.12	.19	
$Error_2$	23.70	38	.62		
V x R	.45	2	.23	.41	
V x R x G	.01	2	.00	.01	
$Error_3$	20.87	38	.55		
Period (P)	269.64	1	269.64	130.55	<.00001
P x G	4.07	1	4.07	1.97	
$Error_4$	39.24	19	2.06		
V x P	2.17	1	2.17	2.17	
V x P x G	.03	1	.03	.03	
$Error_5$	19.02	19	1.00		
R x P	116.79	2	58.40	51.54	<.00001

Table A (Continued)

Source	SS	df	MS	F	p
R x P x G	2.32	2	1.16	1.02	
$Error_6$	43.05	38	1.13		
V x R x P	.86	2	.43	.85	
V x R x P x G	1.05	2	.53	1.03	
$Error_7$	19.44	38	.51		

Appendix H

Source Table for Analysis of Variance of Heart Rate Change (BPM) Experiment 1

Table A

Analysis of Variance of Heart Rate Change (BPM) As a Function of Experience, Type of Vocalization, Level of Risk, and Seconds

Source	SS	df	MS	F	p
Group (G)	569.23	1	569.23	1.75	
$Error_b$	6820.88	21	324.80		
Vocalization (V)	69.99	1	69.99	1.25	
V x G	352.92	1	352.92	6.29	<.02
$Error_2$	1178.61	21	56.12		
Risk (R)	102.80	1	102.80	3.29	<.8
R x G	57.10	1	57.10	1.83	
$Error_3$	655.77	21	31.23		
V x R	8.43	1	8.43	.22	
V x R x G	381.29	1	381.29	9.88	<.005
$Error_4$	810.27	21	38.58		
Seconds (S)	239.56	9	26.62	.32	
S x G	271.30	9	30.14	.37	
$Error_5$	15576.09	189	82.41		
V x S	569.92	9	63.32	6.08	<.00001
V x S x G	63.20	9	7.02	.67	
$Error_6$	1969.30	189	10.42		
R x S	171.80	9	19.09	1.58	
R x S x G	75.49	9	8.39	.69	

7

Table A (Continued)

Source	SS	df	MS	F	p
$Error_7$	2288.30	189	12.11		
V x R x S	330.79	9	36.75	2.75	<.005
V x R x S x G	230.27	9	25.58	1.91	<.05
$Error_8$	2525.98	189	13.36		

Appendix I

Taped Instructions for Trial 1

(Experiment 2)

Experiment 2

Taped Instructions: Trial 1 (Tapes A1-4)

All instructions will be communicated to you over the speaker prior to each trial, that is, instructions for trial 1, as well as for trial 2. You will now hear instructions for trial 1. You are going to hear four infant cries. Each cry you hear will be 30 s long, and each cry will be separated from the next by a 5 min period of silence. During the first minute of this period of silence you will be asked to rate the sound you have just heard on the eight different rating scales that appear on each page of the rating booklet. You should also choose from the list of six possible caregiving responses located at the bottom of each page one response that seems most appropriate for the cry you have just heard. This procedure will be repeated until you have heard, rated, and selected a caregiving response for all four cries. (Pause) Are there any questions?

In front of you is a panel of seven lights which are turned on and off by the dial below your right hand. These lights will represent your level of arousal during the session, and before and after each cry you will be asked to indicate your level of arousal by turning the dial to the right or to the left. There will be a practice trial, and specific instructions will be given as to how to use this panel of lights, as well as the rating scales. Please try to move as little as possible as this interferes with our readings. If at any time during the experiment you should become distressed for one reason or another, do not hesitate to inform the experimenter. We will terminate the experiment at any time upon your request. Do you have any questions? (Pause) We will now have the practice trial where you will hear *only* the cries of two infants. We will, however, go through all the steps as we would once the experiment begins, so that you become familiar with the task.

The center light on the panel in front of you is now turned on. Turning the dial to the left or right, turns on lights in either direction. Try it for a few seconds, finishing off by bringing it back to the center position. (Pause) Note the word "now" beneath this center light. Try to think of this center light as representing your level of arousal, tension, nervousness, or excitement right now. Use it as a reference point against which you will compare any changes during the session. If you feel *slightly aroused* you would turn on light number +1 or if you feel *very aroused* you would turn on light number +3. On the other hand, if you feel *slightly relaxed* you would turn on light number -1, or light number -3 if you are *very relaxed*. (Pause) Please indicate your level of arousal now. (30 s Pause) After each infant cry please rate the cry on the eight scales provided. In addition, please circle the caregiving response from the six responses listed that you feel is most appropriate. To use a scale, circle the number that represents the degree to which you feel one of the adjectives applies to the sound that you have heard. If neither adjective is applicable, circle the number 4 which is the neutral point. On the scale, 1 or 7 means "definitely appropriate," 2 or 6 means "moderately appropriate," 3 or 5 "slightly appropriate." As an example let us discuss today's weather; on a scale of 1 to 7, 1 being "hot" and 7 being "cold," how would you rate today's weather? (Pause for response) Now, you will hear the first cry, please listen carefully and begin rating only after the cry has stopped. Remember, there will be a 5-min period of silence following each cry. Once you have indicated your level of arousal, as you will be instructed to do each time the cry stops, you should use the remainder of the first min to rate, as well as to select a caregiving response for the cry you have just heard (1-min period of silence followed by first practice cry). (Immediately following presentation of cry number 1) Please indicate your level of arousal now by again turning the knob below your right hand. (5-min period of silence after 4-min) Please indicate your level of arousal now. (After presentation of cry number 2) Please indicate your level of arousal now. (2-min -- following rating of cry number 2) If there are no questions there will now be a short rest period prior to commencing trial 1 of the experiment. (5-min break)

Experiment Now Begins

The experiment will now begin; the center light on the panel in front of you is now turned on. Note the word "now" beneath the center light. Try to think of this center light as representing your level of arousal, tension, nervousness, or excitement right now. Use it as a reference point against which you will compare any changes during the session. If you feel slightly aroused you would turn on light number +1, or if you feel very aroused you would turn on light number +3. On the other hand, if you feel slightly relaxed you would turn on light number -1, or light number -3 if you are very relaxed. Remember, the center light in front of you is your reference point against which you will compare any changes in arousal during the session. (5-min period of silence preceding each cry; after 4 minutes) Please indicate your arousal level now, always finishing off by bringing it back to the center position. (After another minute of silence presentation of the first cry).

Appendix J

Taped Instructions for Trial 2

(Experiment 2)

Taped Instructions: Trial 2 (Tapes B1-4, C1-4)

Now you will hear instructions for the final trial. You will again hear four 30-s infants' cries and you will be asked to repeat all tasks performed on the previous trial. However, now you will be given information about the infants from whom the cries were recorded. Each cry you hear will represent one of the categories of: sick preterm, healthy preterm, sick fullterm, and healthy fullterm. The identification of each cry will be given to you before the cry is heard, immediately after you have indicated your level of arousal. Like the previous trial, you will be asked to indicate your level of arousal before and after each cry. The center light in front of you remains your reference point against which you will compare any changes in arousal during the session. You are also asked, like the previous trial, to rate and select a caregiving response during the first minute of silence following each cry. You are reminded that any movement interferes with our readings. Please try to move as little as possible, listen carefully to each cry, and begin rating only after the cry has stopped. Remember, there will be a 5-min period of silence following each cry. Once you have indicated your level of arousal, as you will be instructed to do each time the cry stops, you should use the remainder of the first minute to rate as well as to select a caregiving response for the cry you have just heard. Are there any questions? (Pause) If there are no further questions the experimental trial will begin after a short pause. (5-min Pause)

Experiment Now Begins: Trial 2 (Tapes B1-4, C1-4)

The trial will now begin. (5-min period of silence preceding each cry: after the first 4 minutes) Please indicate your level of arousal now always finishing off by bringing it back to the center position (Brief Pause -- 5 s) Healthy fullterm. (After another minute of silence presentation of the first cry) etcetera.

Taped Instructions: Trial 2 (Tapes D1-4)

Now you will hear instructions for the final trial. You will again hear four 30-s infants' cries and you will be asked to repeat all tasks performed on the previous trial. That is, like the previous trial, you will be asked to indicate your level of arousal before and after each cry. The center light in front of you remains your reference point against which you will compare any changes in arousal during the session. You are also asked, as in the previous trial, to rate and to select a caregiving response during the first minute of silence following each cry. You are reminded that any movement interferes with our readings. Please try to move as little as possible, listen carefully to each cry, and begin rating only after the cry has stopped. Remember, there will be a 5-min period of silence following each cry. Once you have indicated your level of arousal, as you will be instructed to do each time the cry stops, you should use the remainder of the first minute to rate as well as to select a caregiving response for the cry you have just heard. Are there any questions? (Pause) If there are no further questions, the experimental trial will begin after a short pause. (5-min Pause)

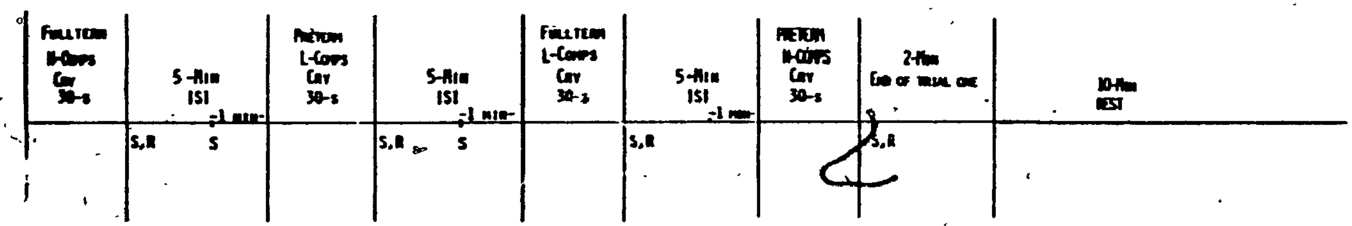
Experiment Now Begins: Trial 2 (Tapes D1-4)

The trial will now begin. (5-min period of silence preceding each cry; after 4 minutes) Please indicate your level of arousal now always finishing off by bringing it back to the center position. (After another minute of silence presentation of the first cry) etcetera.

Appendix K

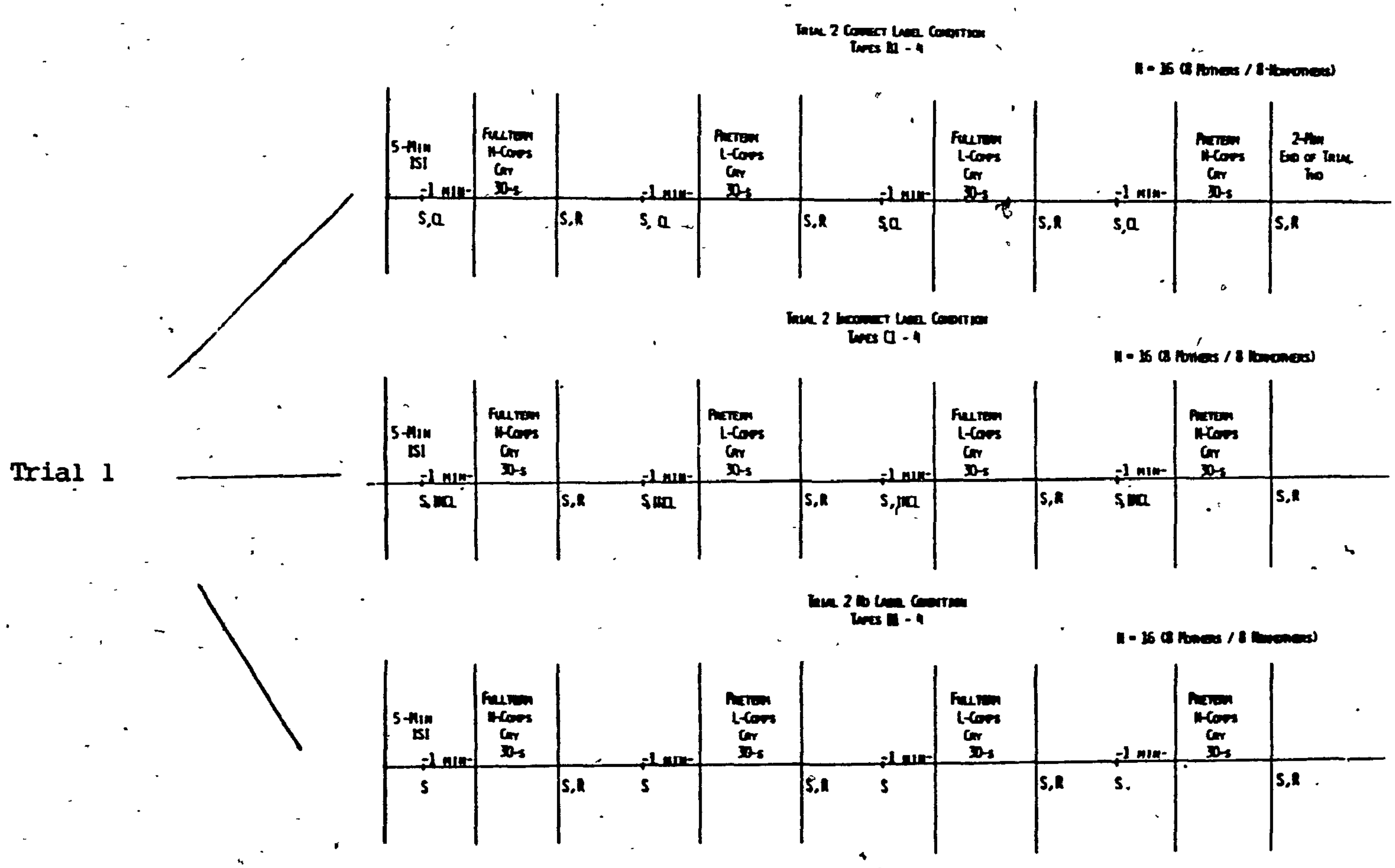
Experiment 2: Experimental Protocol and Presentation of Stimuli

TRIAL 1
(No Information or Baseline) For All Subjects
Tapes A2 - 4



N = 48 (24 Mothers / 24 Nonmothers)

S = Subjective Arousal Rating
R = Vocalization Rating on 8 Scales and Caregiving Response
CL = Correct Label
INCL = Incorrect or Reversed Label
NL = No Label
Heart Rate Monitored Continuously


Trial 2
Trial 1
5-Min ISI
-1 min-
S,R
30-s
2-Min End of Trial Two

Appendix L

Rating Scale Assessing Effectiveness of Infant Cry Labels

This questionnaire is designed to get your impressions of the association between the identifications that were given to you for the cries and the actual cries that you heard. In other words, on a scale of 1 to 7, 1 being very appropriate and 7 being not appropriate at all, how would you rate the identification given based on the cry you heard?

Sick Preterm:

very appropriate — not appropriate at all

1 2 3 4 5 6 7

Sick Fullterm:

not appropriate at all — very appropriate

1 2 3 4 5 6 7

Healthy Preterm:

very appropriate — not appropriate at all

1 2 3 4 5 6 7

Healthy Fullterm:

not appropriate at all — very appropriate

1 2 3 4 5 6 7

Appendix M

Source Tables for Analyses of Variance of Caregiving Dimensions: Trial 1 Only (Experiment 2)

Table A

Analysis of Variance of Caregiving Dimension "Effectiveness" as a Function of Experience, Type of Vocalization, and Level of Risk

Source	SS	df	MS	F	p
Groups (G)	.00	1	.00	.00	
$Error_b$	120.61	42	2.87		
Vocalization (V)	2.33	1	2.33	.95	
V x G	7.65	1	7.65	3.12	<.08
$Error_1$	102.96	42	2.45		
Risk (R)	.26	1	.26	.09	
R x G	9.75	1	9.75	3.32	<.07
$Error_2$	123.44	42	2.94		
V x R	16.93	1	16.93	8.46	<.01
V x R x G	2.25	1	2.25	1.12	
$Error_3$	84.04	42	2.00		

Table B

Analysis of Variance of Caregiving Dimension "Tender and Caring" as a Function to Experience, Type of Vocalization, and Level of Risk

Source	SS	df	MS	F	p
Groups (G)	.57	1	.57	.19	
$Error_b$	129.49	42	3.08		
Vocalization (V)	3.15	1	3.15	2.04	<.1
V x G	14.74	1	14.74	9.53	<.004
$Error_1$	64.96	42	1.55		
Risk (R)	1.06	1	1.06	.44	
R x G	.38	1	.38	.16	
$Error_2$	101.41	42	2.41		
V x R	19.03	1	19.03	10.74	<.002
V x R x G	.85	1	.5	.48	
$Error_3$	74.44	42	1.77		

Appendix N

Source Table for Analysis of Variance of Heart Rate Change (BPM): Trial 1 Only (Experiment 2)

Table A

Analysis of Variance of Heart Rate Change (BPM) as a Function of Experience, Type of Vocalization, Level of Risk and Seconds

Source	SS	df	MS	F	p
Groups (G)	433.20	1	433.20	2.09	
$Error_b$	9549.72	46	207.60		
Vocalization (V)	655.67	1	655.67	6.39	<.01
V x G	17.25	1	17.25	.17	
$Error_1$	4721.93	46	102.65		
Risk (R)	492.07	1	492.07	2.99	<.09
R x G	4.80	1	4.80	.03	
$Error_2$	7561.97	46	164.39		
V x R	91.00	1	91.00	.70	
V x R x G	40.25	1	40.25	.31	
$Error_s$	5990.99	46	130.24		
Seconds (S)	3198.36	9	355.37	8.46	<.00001
S x G	889.29	9	98.81	2.35	<.01
$Error_4$	17380.59	414	41.98		
V x S	481.03	9	53.45	1.27	
V x S x G	675.36	9	75.04	1.79	<.07
$Error_5$	17386.26	414	41.99		
R x S	453.77		50.42	1.24	
R x S x G	616.00		68.44	1.69	<.09
$Error_6$	16719.88		40.56		

Table A (Continued)

Source	SS	df	MS	F	p
V x R x S	250.05	9	27.78	.65	
V x R x S x G	208.55	9	23.17	.54	
Error 7	17734.65	414	42.84		

Appendix O

Source Table for Analysis of Variance of

Heart Rate Change (BPM) (Trial 1 and 2):

Experiment 2

Table A

Analysis of Variance of Heart Rate Change (BPM) as a Function of Experience, Conditions, Type of Vocalization, Level of Risk, Trials and Seconds

Source	SS	df	MS	F	p
Groups (G)	728.69	1	728.69	1.79	
Conditions (C)	295.75	2	147.88	.36	
G x C	252.01	2	126.00	.31	
$Error_b$	16667.93	41	406.53		
Vocalization (V)	632.92	1	632.92	4.36	<.04
V x G	67.05	1	67.05	.46	
V x C	383.39	2	191.70	1.32	
V x G x C	349.74	2	174.87	1.21	
$Error_1$	5947.18	41	145.05		
Risk (R)	95.18	1	95.18	.65	
R x G	131.75	1	131.75	.90	
R x C	22.53	2	11.27	.08	
R x G x C	238.63	2	119.31	.81	
$Error_2$	6023.85	41	146.92		
V x R	180.21	1	180.21	1.22	
V x R x G	18.04	1	18.04	.12	
V x R x C	247.56	2	123.78	.84	
V x R x G x C	42.52	2	21.26	.14	
$Error_3$	6072.93	41	148.12		

Table A (Continued)

Source	SS	df	MS	F	p
Trial	5.83	1	5.83	.07	
T x G	56.53	1	56.53	.69	
T x C	112.81	1	56.41	.69	
T x G x C	651.53	1	325.76	3.99	<.03
Error$_4$	3348.58	41	81.67		
V x T	129.88	1	129.88	1.64	
V x T x G	2.62	1	2.62	.03	
V x T x C	150.54	2	75.27	.95	
V x T x G x C	103.19	2	51.59	.65	
Error$_5$	3245.88	41	79.17		
R x T	605.71	1	605.71	3.85	<.06
R x T x G	124.94	1	124.94	.79	
R x T x G	331.74	2	165.87	1.06	
R x T x G x C	284.45	2	142.22	.90	
Error$_6$	6444.02	41	157.17		
V x R x T	.45	1	.45	.01	
V x R x T x G	27.08	1	27.08	.35	
V x R x T x C	15.02	2	8.51	.10	
V x R x T x G x C	554.47	2	274.24	3.56	<.04
Error$_7$	3188.55	41	77.77		
Seconds (S)	4462.52	9	495.84	8.83	<.00001
S x G	410.68	9	45.63	.81	

Table A (Continued)

Source	SS	df	MS	F	p
S x C	1526.78	18	84.82	1.51	
S x G x C	306.29	18	17.01	.30	
Error$_{8}$	20717.25	369	56.14		
V x S	305.68	9	33.96	.70	
V x S x G	383.03	9	42.56	.88	
V x S x C	509.92	18	28.33	.58	
V x S x G x C	988.23	18	54.90	1.13	
Error$_{9}$	17896.21	369	48.50		
R x S	327.20	9	36.36	1.01	
R x S x G	230.77	9	25.64	.71	
R x S x C	486.00	18	27.00	.45	
R x S x G x C	1252.28	18	69.57	1.93	<.01
Error$_{10}$	13334.21	369	36.14		
V x R x S	225.35	9	25.04	.64	
V x R x S x G	263.87	9	29.32	.75	
V x R x S x C	543.72	18	30.21	.77	
V x R x S x G x C	579.55	18	32.20	.82	
Error$_{11}$	14507.76	369	39.32		
T x S	697.95	9	77.55	1.89	<.05
R x S x G	805.81	9	89.53	2.18	<.02
T x S x C	848.01	18	47.11	1.15	
T x S x G x C	693.21	18	38.51	.94	
Error$_{12}$	15174.34	369	41.12		

Table A (Continued)

Source	SS	df	MS	F	p
V x T x S	791.18	9	87.91	2.02	<.04
V x T x S x G	386.44	9	42.94	.99	
V x T x S x C	501.04	18	27.83	.64	
V x T x S x G x C	814.84	18	45.27	1.04	
$Error_{13}$	16074.47	369	43.56		
R x T x S	414.45	9	46.05	1.08	
R x T x S x G	698.50	9	77.61	1.83	<.06
R x T x S x C	823.96	18	45.77	1.08	
R x T x S x G x C	577.97	18	32.11	.76	
$Error_{14}$	15690.33	369	42.52		
V x R x T x S	189.43	9	21.05	.51	
V x R x T x S x G	302.06	9	33.56	.81	
V x R x T x S x C	536.43	18	29.80	.72	
V x R x T x S x G x C	924.39	18	51.35	1.24	
$Error_{15}$	15304.93	369	41.48		