THE IMPACT OF INFANT VOCALIZATIONS ON AN ADULT LISTENER

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A Thesis

in

The Department

of

Psychology

Presented in Partial Fulfillment of the Requirements
for the degree of Master of Arts at
Concordia University
Montréal, Québec, Canada

November 1981

ABSTRACT

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Differences in response to preterm and fullterm infant cries were investigated in 2 groups of women (16 mothers of 1 infant each $\bar{X}$ age 12.4 mos and 16 nonmothers). Each subject heard 24 30-sec vocalizations presented in 1 session in 4 blocks of 6 vocalizations each. Blocks consisted of 6 recordings of cries of normal 2- to 5-day-old fullterm infants, 6 recordings of normal preterm infants ($\bar{X}$ GA = 32.2 weeks) prior to discharge from hospital at approximately 38 weeks postconceptual age, 6 recordings of the same preterm infants at 44 weeks postconceptual age, and 6 control recordings of infant coos. Subjects rated each vocalization on the 8 Zeskind and Lester rating scales during a 1-min interstimulus interval. Cries differed from coos in that they induced feelings of increased arousal and were rated less favourably on all Zeskind and Lester scales. No differentiation was obtained on the autonomic measures; diastolic blood pressure, skin conductance level, and skin conductance response frequency increased to cries and coos, while heartrate variability decreased to them. Heartrate (beats per min estimation) and systolic blood pressure were unaffected by the stimuli. No evidence was obtained of an effect of maternal experience, nor of any uniquely "aversive" or "sick" quality to the preterm infant's cry. On the contrary, the less mature preterm infant cries were rated most "healthy" and least "piercing". It was suggested that audiotapes of infant coos be incorporated in studies investigating psychophysiological responses

to infant cries. The suggestion was also made that cries of young preterm infants may be weak elicitors of caregiving behaviour in adults.

Acknowledgements

To Dr. Nancy Taylor, my sincerest gratitude for her unfailing support, guidance, patience and understanding throughout the course of the investigation and preparation of the thesis.

To Dr. Peter Seraganian, I also wish to express gratitude for sharing his expertise, as well as for his interest and encouragement throughout the course of the study. Thanks is also due to Dr. D. Kaloupek for his interest and suggestions.

Special thanks is due to Dr. A. Papageorgiou, Neonatologist-in-Chief of the Jewish General Hospital, who kindly allowed access to the infants in the Neonatal Intensive Care Unit, thus making the study possible. My sincerest appreciation to him and to Dr. I. Kunos, Assistant Neonatologist-in-Chief who provided access to the follow-up clinic and gave her support. Thanks is also due to Ms. Joyce Mackay, R.N., for her support and interest.

I wish to express special thanks to Mr. David Sinyor, for his invaluable assistance throughout the investigation. My sincerest gratitude to him for the tremendous patience he exercised and for sharing his expertise in the use of the computer and other technical equipment.

Finally, for the many others, too numerous to name who so kindly assisted me in soliciting subjects for the study, I wish to express my appreciation.

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The present study investigated how an adult listener's response to the preterm infant's cry was affected by maternal experience and maturation of the cry. Crying, a frequent infant behavior, can elicit feelings of concern, protectiveness, and nurturant actions, or feelings of anger and destructive actions (Oswald, 1963; Stone, Smith, & Murphy, 1973). Although most cries elicit nurturant actions, crying is a primary precipitant of abuse for young infants (Murray, 1979). Because preterm infants are at special risk for child abuse (Elmer & Gregg, 1976; Fontana, 1973; Hunter, Kilstrom, Kraybill & Loda, 1978; Klein & Stern, 1971), researchers have recently investigated characteristics of the preterm infant's cry. Although Frodi et al. (1978b) reported that the preterm infant's cry recorded at time of discharge is more aversive than that of a fullterm infant, the two studies that have attempted to verify this finding have failed to do so (Bryan, Note 1; Friedman, Zahn-Waxler, & Radke-Yarrow, Note 2). Moreover, recently researchers (Sostek, Quinn, & Davitt, 1979) have noted that preterm infants at the time of discharge cry little. In addition, young preterm infants have difficulty coordinating a fullblown cry at least through the second and third months of life (Ferber & Wolff, 1981, cited in Boukydis, Note 3). On the other hand, at eight months of age high risk preterm infants are excessively irritable (Goldberg, Brachfield, & Divitto, 1980); thus both irritability and aversive characteristics of the cry may develop with maturation of the infant. How maturational changes in the cry affect the mother's perception of it is not known, although one might speculate that an experienced caregiver might be more tolerant of an especially aversive cry since Zeskind and Lester (1978) have reported that parents perceive cries as less aversive than nonparents. No published study, however, has investigated how maternal experience affects perception of preterm infant cries.

The suggestion that preterm infant cries might be perceived as especially aversive came from a study by Frodi et al. (1978a). In a study of parents, Frodi et al. investigated the effects of infant stimuli on adult behavioral propensities, and tried to determine whether mothers and fathers differed in their responsiveness to the infant signals of crying and smiling. Parents of 9-month-old infants watched a 6-minute videotape presentation of an infant during which time their skin conductance and blood pressure were monitored. Mood scales were also administered. Subjects saw either a crying or a smiling baby labelled as "normal", "difficult", or "premature" to equal proportions of the sample. All parents completed standard questionnaires concerning their own child. Results suggested that a smiling infant triggered positive emotions and negligible changes in autonomic arousal, whereas a crying infant was perceived as aversive and elicited diastolic blood pressure and skin conductance increases. Increases in skin conductance amplitude were especially apparent when the infant was labelled as "premature". No differences were found between mothers and fathers in their responses to the stimulus baby or in their perception of their own child. In an extension of this study, Frodi et al. (1978b) sought both to replicate the finding by Frodi et al. (1978a), and also to determine whether the facial appearance and cries of preterm and fullterm infants would elicit different physiological responses. Parents of 5-month-old infants saw either a normal fullterm newborn or a preterm infant who was in turn quiescent, crying, 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. Results indicated that crying in general increased diastolic blood pressure and skin conductance amplitude in both mothers and fathers. Analysis of the mood adjective checklist data also suggested that these cries were aversive and irritating. A significantly greater increase of diastolic blood pressure, skin conductance amplitude, and a more rapid heartrate acceleration, as well as greater self-reported feelings of aversion occurred to preterm than to fullterm features. Further analyses indicated that the sound of the cry was particularly important, although the effect of prematurity was more intense when both auditory and visual information were provided. Frodi et al. (1978b) interpreted these findings as evidence that the high-pitched cry of a premature infant is considered more aversive and elicits greater autonomic arousal in mothers and fathers than the cry of a fullterm infant.

Only recently has the effect of parental experience on response to infant cries been investigated. Zeskind and Lester (1978) sought to determine the relationship between ratings of neonatal cry features and obstetric histories using both parents, and unmarried adults with no children or any professional experience with infants or young children. Number of offspring (parity) of the parents was not reported. Subjects heard 10-sec pain cries of eight low-complications and eight high-complications fullterm infants (risk status based on number of prenatal and perinatal obstetric complications) 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 of cry sounds. Results from this study indicated that clinically healthy normal fullterm newborns who may be at risk because of a high number of complications could be distinguished from low-complications infants. All subjects rated the high-complications infant cries as more aversive, grating, sick, urgent, distressing, piercing, discomforting, and more arousing than low-complications infants. Parents rated all cries as less aversive than nonparents. In addition, factor analysis revealed that whereas the low-complications infant cries were perceived along a single dimension reflecting the unpleasant qualities of the cry, the high-complications infant cries also conveyed information about the condition of the infant. Specifically, the cry sounded "sick" and "urgent". Zeskind and Lester have taken the view that the high-pitched cry characteristic of infants with a wide range of medical conditions is a signal with evolutionarily adaptive qualities.

In an extension of the Zeskind and Lester (1978) study, Zeskind (1980) tried to determine if the underlying perceptual dimensions of the cries of the infant at risk signal different needs. Zeskind, employing the same stimuli as Zeskind and Lester (1978), had parents of mixed parity (1 to 3 children, none of whom were less than 8 months of age) and non-parents (reported having no children) listen to 10-sec cry segments and during interstimulus intervals choose a response that seemed most appropriate for the cry sound from a list of possible caregiving responses. Choices included (a) feed, (b) cuddle, (c) pick-up, (d) clean, (e) give pacifier, and (f) wait and see. These caregiving responses were then 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". Results revealed that the cries from the high-risk infants elicited from parents, but not from nonparents, 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 by parents, but not by nonparents to high risk infant cries were more consistent than to low risk infant cries. Moreover, the classification of modal responses into functional categories also revealed that 21 of 30 parents gave contact-comfort kinds of responses to the cries of high risk infants, while none gave undirected responses. These results were interpreted to support a functional role for the cries of the "at risk" infant. Further, it was speculated that perhaps experience with infants may be necessary to translate the 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.

Boukydis (1980) also found some important parity effects in patterns of adult responding to infant cries. Boukydis, in a study of nonparents, primiparous couples (own infant 3- to 5-months old), and multiparous couples (one infant 3- to 5-months old) investigated subjects' skin potential response to, as well as their ratings of the cries of normal 4- to 6-month-old "difficult", "average", "easy", temperament rated fullterm infants (infant rated on Infant Characteristic Questionnaire, Bates, Bennett-Freeland, & Lounsbury, 1979) on the Zeskind and Lester scales. Although there were no effects of parity evident on the Zeskind and Lester scales since cries of "difficult" infants were rated most negatively on four of the eight scales by all subjects, the physiological arousal data indicated that primiparous mothers had the highest level of arousal overall, with nonparents next, and that multiparous parents had lowest levels of arousal. Both multiparas and nonparents showed highest levels of arousal to the "difficult" type cries and least to the "easy" type cries, while primiparas had highest level of arousal to "average" type cries. Boukydis interpreted these data as indicating that the "average" type cry samples may have been most representative of the rhythmic and temporal patterns of hunger cries, and suggested that coupled with primiparous parents' high level of concern for distinguishing feeding cries from other distress cries in their own infants, the "average" type cries may have been more salient.

Two recent studies that employed the Zeskind and Lester scales in an attempt to explore further differences in adults' perception of preterm and fullterm infant cries have both failed to replicate the findings of Frodi et al. (1978b). Friedman et al. (Note 2) had mothers rate the cries of four healthy fullterm newborns, four low risk preterm infant and four moderate risk preterms (risk status based on cost of hospitalization) on five rating scales (four scales were adopted from the Zeskind and Lester scales and one scale related to maturity of the infant was added). Cries of preterm infants were not uniformly rated as more urgent, grating, sick, arousing, or immature than cries of fullterm infants of the same postconceptual age (gestational age plus age from birth) and of similar racial and socio-economic background. Although cries of medium risk infants were consistently rated as most negative, some low risk preterm cries were rated as less urgent, more pleasing, healthy, soothing, or mature than cries of fullterm intants. Friedman et al. in interpreting these data, suggested that caution be exercised in making generalizations about the aversiveness of preterm infant cries and the corresponding implications for caregiver-child interaction, and that adults' responses to the cry of one preterm infant in the Frodi et al. study might have been dependent on variables other than the infant's prematurity. There was some suggestion from the Friedman et al. study that the amount of neonatal medical risk the infant suffered and the infant's sex may be contributing to the perceived aversiveness of the cry.

Bryan (Note 1) specifically investigated how maternal experience affected both the perception of preterm and fullterm infant cries, and the autonomic response to them. The preterm infants were recorded prior to discharge at a postconceptual age of approximately 36 weeks, and the fullterms were 2 to 3 days old, when the cries were recorded. Mothers of mixed parity and women without maternal experience participated in two test sessions. A 20-sec recording of a tone served as a control stimulus in each session. Subjects rated the sounds on the eight Zeskind and Lester scales during a 1-min interstimulus interval. Heartrate decelerated and skin conductance increased during all cries; blood pressure was unaffected by the stimuli. All subjects rated the fullterm infant cries as more urgent, grating, arousing, piercing, and distressing, than the preterm infant cries. On the basis of the Zeskind and Lester (1978) study, Bryan had predicted that mothers would be relatively more sensitive to the "sickness" and "urgency" of preterm infant cries. This specific prediction was not borne out; mothers, however, did rate preterm cries as more arousing, discomforting, and distressing than nonmothers. Mothers also rated fullterm infant cries as more "urgent" than nonmothers. The findings were interpreted as suggesting that mothers appeared to be more sensitive to infant signals than nonmothers, and that maternal experience heightens sensitivity to certain aspects of infants' cry features. Further, it was speculated that perhaps the perception of fullterm infant cries as more aversive than preterm cries by mothers and nonmothers reflected the preterm infant's immaturity and inability to coordinate a fullblown cry.

In summary, previous findings suggest that both parents and nonparents perceive the cries of different populations differently; however, conclusive evidence in support of the hypothesis that preterm infant cries in general are perceived as more aversive than fullterm infant cries seems lacking. If preterm infant cries are systemically perceived as more aversive than cries of fullterm infants, the effects of these cries may contribute to the nonharmonious interactions of some preterm infants with their caregivers. It is therefore imperative that adults' perception of preterm infant cries be systematically investigated. The purpose of the present research was to examine the impact of the standard cry of preterm and fullterm infants on women with and without maternal experience. The goal was to determine whether the cry features of preterm infants in the absence of visual information, would be perceived by mothers and nonmothers as more aversive subjectively, as well as elicit greater increases in autonomic arousal than those of fullterm infants. Both physiological responses to the cries and subjective perceptions of them were investigated because it was felt that data obtained from both sources combined would more sensitively reflect behavioral tendencies. In addition, the relationship between the two kinds of measures was of interest. Subjective perceptions of the vocalizations were assessed by using the Zeskind and Lester rating scales. The specific physiological indices monitored were blood pressure, heartrate, and skin conductance. In order to provide an index of general arousal, subjects were asked to indicate their arousal level on a 7-point illuminated scale; this measure has previously been shown to be sensitive to changes in arousal levels during periods of stress induced by mental tasks (Schwartz, Note 4).

The research paradigm employed was a variant of that typically used to investigate the influence of infant cries on caregivers. One important criticism of this body of research is the lack of adequately controlled studies; only one published study to date has incorporated audiotapes of infant vocalizations as control stimuli (Frodi & Lamb, 1980). Frodi et al. (1978a) used infant smiles as control stimuli. Wisenfeld et al. (cited in Boukydis, Note 1) and Bryan (Note 2) attempted to employ some form of auditory control stimuli; audiotapes of the sound of a tone were used in both cases. The present research employed audiotapes of infant coos and babbles as control stimuli.

Since the effects of maternal experience are unclear, primiparous mothers and women without maternal experience were compared. To investigate how the impact of the preterm infants' cry on an adult caretaker changes with maturation of the infant, subjects were exposed to recordings of preterm infant cries made at 38 weeks postconceptual age, as well as recordings made from the same infants at 44 weeks of age. In addition, differences in the impact of preterm and fullterm infant cries were explored by exposing subjects to recordings of the preterm infant cries as well as to recordings of the cries of normal 2- to 5-day-old fullterm newborns. The effect of maturation was of interest since Ferber and Wolff (cited in Boukydis, Note 3) have reported that very young preterm infants have trouble coordinating a fullblown cry. Hence both their spontaneous and elicited cries appear to incorporate a series of preliminary inspiration/expiration with little voiced elements before arising to a short duration, high pitched, sometimes rhythmical cry. This cry attempt feature is still present in the second and third month of the infant's life. Boukydis (Note 3) has suggested that here the Zeskind and Lester (1978) second dimension of sickness/urgency in adults' perception of the cries of infants at risk may be relevant. The constellation of sickness/urgency may supersede the perceived aversiveness of cries of young premature infants and high complications infants, since there may be some level above which a cry has enough duration, organized pitch, and intensity, such that the first dimension of aversiveness becomes predominant. Thus the cries of more mature preterm infants might be more aversive than the cries of young preterm infants.

It was hypothesized that the infant coos and babbles would be perceived as pleasant stimuli, while infant cries would be perceived as aversive stimuli. Thus cries would be rated less favourably than coos on the Zeskind and Lester scales; in addition, cries would increase arousal level more than coos and babbles, and would elicit greater increases in blood pressure, heartrate and skin conductance. It was also predicted that the less mature preterm cries would be perceived as less aversive and more sick than the more mature preterm cries, while the more mature cries of the preterm infants would be perceived as more aversive than the cries of fullterm newborn infants. Thus the older preterm infant cries would be rated most negatively on the Zeskind and Lester scales, elicit greatest increases in arousal level, as well as greatest increases in blood pressure, heartrate, and skin conductance. It was predicted that these effects would be stronger in nonmothers than mothers. No hypothesis was formulated about the effects of the less mature preterm infant cries in contrast to fullterm infant cries. Finally, it was hypothesized that mothers would be relatively more sensitive to the sickness and urgency of the cries of the younger preterm infants than women without maternal experience.

Method

Subjects

Subjects were two groups of caucasian middle-class English speaking females, comprised of 16 primiparous mothers (mothers age: $\bar{X}$ = 29.7 yrs, range = 24-39 yrs; infants' age: $\bar{X}$ = 12.4 mos, range = 2-26 mos) and 16 nonmothers (age: $\bar{X}$ = 29.7 yrs, range = 23-40 yrs) with no prior caretaking experience of an infant under 2 years for as long as 2 weeks, who were selected from students, as well as friends and relatives of students of Concordia University. All subjects were reimbursed for parking costs. In addition, all mothers were offered $8.00 to cover baby sitting costs while they were being tested.

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) monitored heartrate, skin conductance, and reported subjective arousal level. Heartrate was recorded using Beckman Dyna/trace ECG electrodes filled with Beckman electrode electrolyte. 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 of the abdomen at the height of the umbilicus. These areas were first cleansed with alcohol. The signal was processed through a Beckman Type 9857 cardiotachometer coupler. Skin conductance was recorded via Beckman silver-silver chloride electrodes filled with a mixture of Unibase creame (Park-Davis) and 5% saline (500 ml/250 ml), and held in place by adhesive collars. These electrodes were affixed to the thenar and hypothenar sites of the subject's nondominant hand after the area was first cleansed with alcohol. The signal was processed by a Beckman Type 9844 constant voltage (0.5 V) skin conductance coupler. Blood pressure was measured using a Taylor sphygmomanometer (Taylor Instrument Ltd.) with a velcro cuff (bladder dimensions: 23 cm x 13 cm; Model No. 2P1172) and a standard stethoscope (Ford Light Weight Bell Model No. 300). The blood pressure cuff was also applied to the subject's nondominant arm for monitoring of blood pressure manually. 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", "slightly "relaxed", "relaxed", "now" (central reference point), "aroused", "slightly aroused", and "very aroused". The scale was mounted on a mobile square metal trolley (65 cm x 36 cm) which was placed 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 sent into one channel of the polygraph to provide a record of the dial setting. The initial recordings of the 24 infant vocalizations from which a master tape was generated were made using a Uher Report Monitor (Model No. 4400) and a Uher Unidirectional microphone (Model No. 534). For presentation of the stimulus material a Sony stereo tape recorder, Three Head Solid State TC-630 (Sony Corp., Model No. 153722) equipped with two sets of Sony stereo headphones were used.

Stimulus Material

Four experimental tapes (Scotch 3M Audio Recording Tape) of the same 24 vocalizations (18 30-sec recordings of infant cries and 6 30-sec recordings of infant coos) were used. Each of the four tapes contained a latin square randomized sequence of the 24 vocalizations, presented in four blocks of 6 vocalizations each (3 blocks of cries and 1 block of coos). One block of infant cries consisted of 6 recordings of the cries of normal 2- to 5-day-old fullterm infants (Fu) (3 m and 3 f) obtained within a week of the infant's discharge from the Jewish General Hospital nursery, and the other two represented 2 recordings from each of 6 normal preterm infants (3 m and 3 f; gestational age (GA): $\bar{X}$ = 32.2 wks; range = 27.5-36 wks); one (P1) (age: $\bar{X}$ = 38.4 wks; range = 37-39.2 wks) made within a week of the infant's discharge from the premature nursery at the Jewish General Hospital, and the other, (P2) (age: $\bar{X}$ = 43.7 wks; range: = 41.5-44.5 wks) was obtained on the infant's return to the follow-up clinic at the Jewish General Hospital after an average stay of 5 weeks at home. P2 cries were recorded after the infants were undressed and placed on the scale for weighing or during the time they were being measured by the nurse. The microphone was held at approximately 6 inches away from the infants in all cases. In order to facilitate clear Fu and P1 recordings, infants were briefly transferred to a separate empty room in the nursery wing. The microphone was placed in the cot mounted on a stand approximately 6 inches away from the infant. All Fu and P1 cries were spontaneous cries and were recorded just prior to scheduled feedings. Noncrying infants were roused by undressing. The 6 recordings of coos and babbles (coos) were obtained from normal healthy infants (ages ranged from 6 to 12 months) in their homes, or visiting, or attending the follow-up clinics at the Jewish General Hospital and the Montreal Children's Hospital. The microphone was also held on the average 6 inches away from each infant.

Each experimental tape began with a series of instructions followed by a practice trial consisting of two vocalizations. These two vocalizations (1 30-sec segment of a fullterm infant cry and another segment of a preterm infant cry) were not included in the experimental stimuli. Each block of vocalizations was preceeded by a 3-min period of silence and each 30-sec segment of vocalization within a block was separated from the next by a 1-min interstimulus interval. A 5-min rest period interrupted the presentation of the four blocks of vocalizations. All infant cries and coos were equated in intensity. The level of the vocalizations did not drop below

60 dB and did not exceed 100 dB. The characteristic variations in the level of the vocalizations ranged between 60-80 dB and were on the average at similar levels for all infant cries and the coos. The recordings of infant cries were in each case in excess of 30 continuous seconds; hence 30-sec segments were selected from each. Recordings of infant coos, however, were in general comprised of several short periods of vocalizations from each infant, hence these segments were joined together to produce 30-sec segments from each infant.

Psychophysiological Measures

Blood Pressure. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were calculated by taking the average of three consecutive readings obtained before and after each block of six vocalizations. The first 2 min of the 3-min period of silence preceding each block of vocalizations served as the blood pressure baselines. Post readings were obtained immediately after each block of vocalizations. Several studies have shown that increases in DBP sensitively reflect aversion, feelings of anger, or a disposition to aggress (Green, Stormer, & Shope, 1975; Schachter, 1957); while increases in SBP are thought to reflect physiological arousal (Glass, Krakoff, Contrada, Hilton, Kehoe, Mannucci, Collins, Snow, & Elting, 1980; Lacey, 1967).

Heartrate. Two measures of heartrate were obtained. Average heartbeats per minute (HRM) was estimated by taking the average of the three highest beats recorded over consecutive 10-sec segments during 30-sec periods. An acceleration in HRM is thought to be indicative of a defensive type response, reflecting rejection of the external environment, while deceleration of HRM is thought to reflect attentive observation of the external environment (Lacey, 1967). The second measure, heartrate variability (HRV) was calculated by taking the average difference between the three highest beats and the three lowest beats in consecutive 10-sec segments during 30-sec periods. Porges (in press), has suggested that a reduction in HRV may be indicative of a tonic sustained heartrate response, although it is possible to observe a reduction of HRV independent of directional heartrate changes (Lacey, 1967; Porges & Raskin, 1969).

Skin Conductance. Two measures of skin conductance were also obtained. Skin conductance level (SCL) was scored by taking the average of three minimum conductance values from consecutive 10-sec segments during 30-sec periods. The second index was frequency of responses (SCR) equal to or exceeding 0.2 micromhos during 30-sec periods. Research which has attempted to separate the stressful and cognitive components of tasks (Katkin, 1965; Kilpatrick, 1972; Miller & Schmavonian, 1965) has suggested that SCR activity reflects emotional arousal, while SCL reflects level of cognitive activity.

Heartrate and skin conductance measures were scored for 24 30-sec periods throughout the session, for the full duration of each stimulus presentation. A mean score for each subject was obtained on these measures for each block of six vocalizations. The last 30 sec of the 3-min period of silence preceeding each block of vocalizations constituted the heartrate and skin conductance baselines.

Subjective Measures

Subjective Arousal (SAR). The ratings taken from the 7-position dial which ranged 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 equivalent to +3.

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

& Lester, 1978) were presented in rating booklets containing 26 pages of the eight 7-point rating scales. The polarity of these scales were alternated. The scales were (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) distressing - nondistressing (Appendix A). The polarity of four scales were reversed before scoring. Hence for all scales the highest level of aversiveness is represented by 7 and the lowest by 1.

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 heard the 24 vocalizations presented in a single 90-min test session. Four mothers and four nonmothers listened to each experimental tape. Upon arrival the subject was taken to the preparatory room where she was seated and encouraged to relax. The procedure was explained 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. Blood pressure was then measured by slowly inflating and releasing the cuff for three successive readings, with brief interreading pauses. This procedure was standardized for all blood pressure readings during the test session. Finally the subject was asked to fill out a brief questionnaire with respect to maternal experience, age, and level of education achieved (Appendix B). The subject was then shown into the experimental chamber where after being seated in an armchair facing the panel of lights, she was hooked up to the polygraph for continuous heartrate and skin conductance readings. Headphones were then placed on the subject. Stimuli were presented, and all subsequent instructions were communicated to the subject over the headphones. Appendix C 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 rate each vocalization during the minute of silence following each vocalization, as well as to indicate her arousal level before and after each block of six vocalizations by turning the dial below her right hand. Clear instructions and a demonstration were given with respect to filling out the rating 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 encouraged to try to relax. Prior to presentation of the experimental sounds all instructions regarding the task were again repeated. Blood pressure was measured prior to each block of vocalizations following the subject's indicating her subjective arousal level. Post blood pressure readings were obtained immediately after the subject rated the last vocalization in each block, and had again indicated her arousal level.

Results

Psychophysiological Measures

Mean SBP and DBP for mothers and nonmothers before and after the vocalizations are presented in Appendix D. Appendix E contains the means for HRM and HRV, while means for SCL and SCR are presented in Appendix F. A repeated measures experience x type of vocalization x period analysis of variance (ANOVA) was carried out on each psychophysiological measure. The ANOVA source tables are presented in Appendix G. Of the overall ANOVA's performed separately on each measure significant main effects of period were found on: DBP, $F(1,30) = 6.47$, $p < .02$; HRV, $F(1,30) = 16.03$, $p <$

.001, SCL, $F(1,30) = 24.59$, $p < .00001$, and SCR, $F(1,30) = 10.94$, $p < .01$. As Figure 1 shows, these results reflect increases in DBP, SCL, and SCR, and a decrease in HRV during the vocalizations. There was no effect of the stimuli on SBP or HRM, nor was there any main effect of vocalization or maternal experience on any measure.

SCR. The main effect of period obtained on SCR was qualified by a significant interaction between type of vocalization and period, $F(3,90) = 2.47$, $p < .05$ shown in Figure 2. Although Scheffé tests revealed a significant increase in SCR from baseline elicited by P2 cries ($p < .01$) as well as by the infant coos ($p < .05$), a significant difference was found between baseline SCRs for Fu and P2 cries ($p < .05$). In order to remove the confounding effect of different baselines, a gain score analysis of experience x type of vocalization was performed. Appendix G contains the ANOVA source table. The ANOVA of gain scores, however, yielded a main effect of vocalization which approached significance only at the .09 level.

Subjective Measures

SAR. Mean SAR scores pre and post vocalizations, as well as the source table for the repeated measures experience x type of vocalization x period ANOVA performed, are presented in Appendix H. The ANOVA yielded no effect of maternal experience, although significant main effects of vocalization $F(3,90) = 6.70$, $p < .001$ and period $F(1,30) = 33.82$, $p < .00001$ were obtained. These effects were qualified by a significant interaction between type of vocalization and period $F(3,90) = 15.17$, $p < .00001$ shown in Figure 3. The interaction reflected the fact that infant cries increased arousal level, whereas the coos elicited no change in arousal level. Scheffé tests revealed no difference in baseline SARs, but a significant difference between SAR after the coos and SAR after each type of infant cry ($p < .01$).

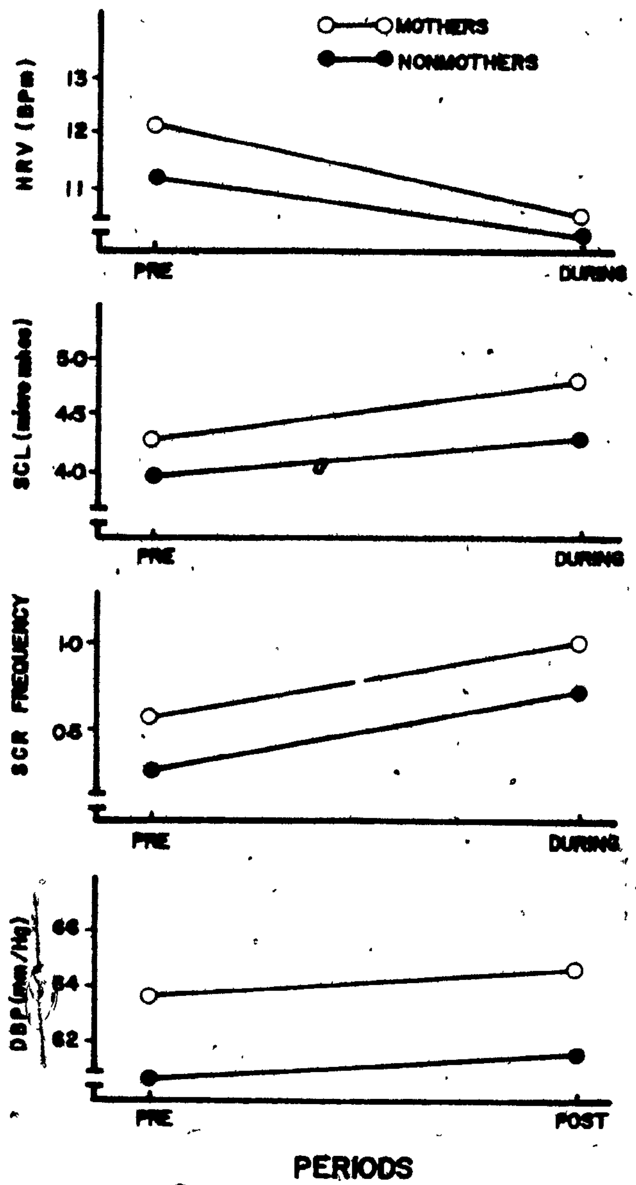

Figure 1. Significant main effects of period reflecting increases in DBP, SCL, and SCR, and a decrease in HRV during the vocalizations.

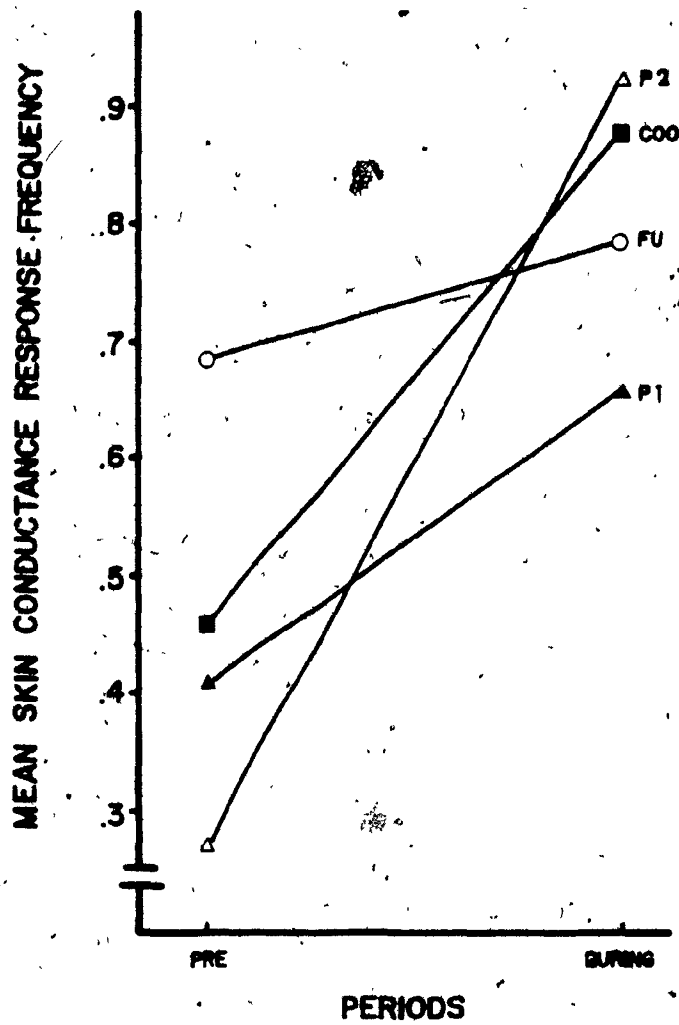

Figure 2. Interaction of vocalizations by period for mean SCR to vocalizations.

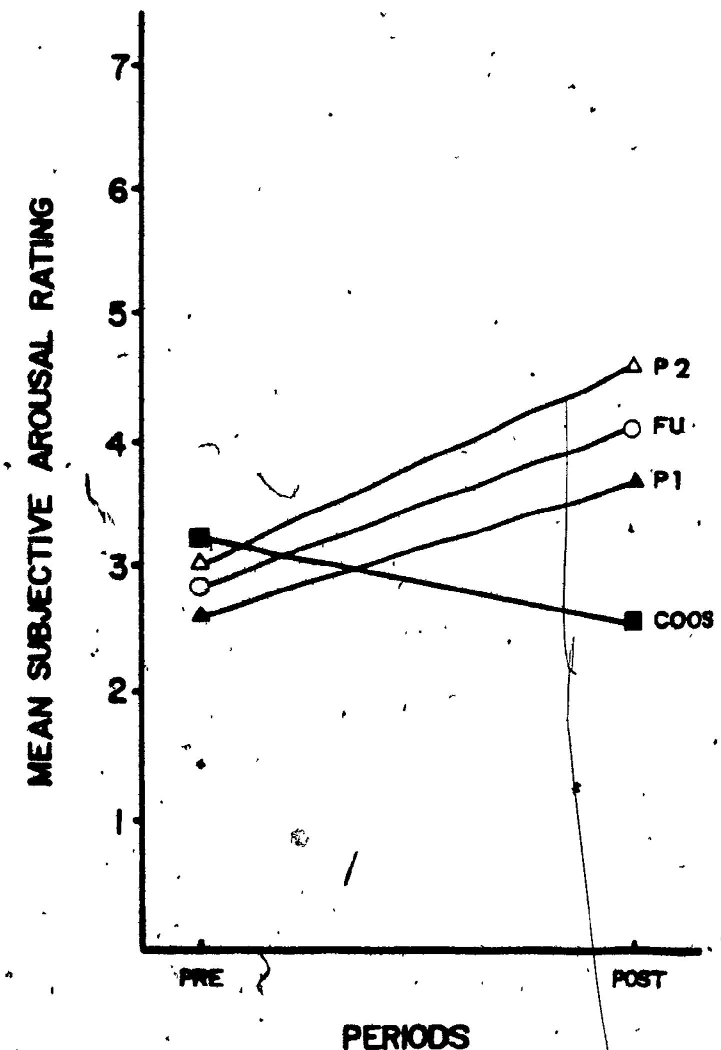

Figure 3. Interaction of vocalizations by period for mean SAR setting pre and post vocalizations.

Z and L Scales. The Z and L scales were analysed by ANOVAs with groups as a between factor and type of vocalization as a repeated factor. Appendix I contains the source tables for these ANOVAs, as well as the mean ratings of all vocalizations by mothers and nonmothers. ANOVAs performed separately for each of the eight scales all yielded significant main effects of vocalization: Urgent, $F(3,90) = 105.51$, $p < .00001$; Grating, $F(3,90) = 252.62$, $p < .00001$; Sick, $F(3,90) = 37.46$, $p < .00001$; Arousing, $F(3,90) = 150.01$, $p < .00001$; Piercing, $F(3,90) = 78.87$, $p < .00001$; Discomforting, $F(3,90) = 140.47$, $p < .00001$; Aversive, $F(3,90) = 75.03$, $p < .00001$, and Distressing, $F(3,90) = 106.99$, $p < .00001$. These results along with subsequent Scheffé tests revealed that all infant cries were rated differently from the coos ($p < .01$) on all eight scales. Coos were rated as less urgent, less grating, less sick, less arousing, less piercing, less discomforting, less aversive, and less distressing than all infant cries. Although the mean ratings of P1 cries tended to be lower than the ratings of both Fu and P2 cries, Scheffé comparisons revealed differences on only two scales. P1 cries were rated as significantly less sick than P2 cries ($p < .10$) and significantly less sick than Fu cries ($p < .05$); there was no significant difference between Fu and P2 cries. P1 cries were also rated as significantly less piercing than both Fu and P2 cries ($p < .05$); no difference was found between Fu and P2 cries. The eight ANOVAs indicated no effect of maternal experience on any scale.

Supplementary Analysis

In order to determine whether an effect of maternal experience would be obtained if mothers of only relatively young infants were investigated, eight mothers with an infant under 8.5 months of age (infant's age: $\bar{X}$ = 6.6 mos, range = 3.5-8.5 mos) were matched with eight nonmothers of comparable ages (mother's age: $\bar{X}$ = 29.1 yrs, range = 24-36 yrs; nonmother's age: $\bar{X}$ = 29.5, range = 25-34 yrs). In doing so, not only were the older subjects not represented in these two groups, but as well, the presentation order of the stimuli was only partially counterbalanced. The analysis was then repeated on the data from the two groups.

Supplementary Analysis: Psychophysiological Measures

Appendix J contains the ANOVA source tables for the physiological measures. Means for SBP and DBP are contained in Appendix D while means for HRM and HRV are presented in Appendix E. Appendix F contains means for SCL and SCR. Significant main effects of period were again obtained for: DBP, $F(1,14) = 4.59$, $p < .05$; HRV, $F(1,14) = 6.22$, $p < .02$, and SCL, $F(1,14) = 14.90$, $p < .002$, which reflected increases in DBP and SCL, and a decrease in HRV. The main effect of period previously obtained on SCR, however, was not replicated, nor was there an effect of type of vocalization on this measure.

HRM. Analysis of HRM revealed a significant interaction between groups and period, $F(1,14) = 7.39$, $p < .02$, shown in Figure 4. This interaction reflected the fact that while mothers and nonmothers did not differ on baseline HRM, mothers tended to respond with deceleration in HRM, and nonmothers tended to respond with acceleration. Scheffé tests however, revealed no significant change from baseline HRM during the vocalizations in either group, although a significant difference was found between the groups during the vocalizations ($p < .05$).

HRV. Analysis of HRV indicated an interaction between groups and period $F(1,14) = 4.46$, $p < .05$ which qualified the main effect of period. The interaction, which is shown in Figure 5, reflected the fact that the decrease in HRV occurred only in the mothers ($p < .05$), with nonmothers show-

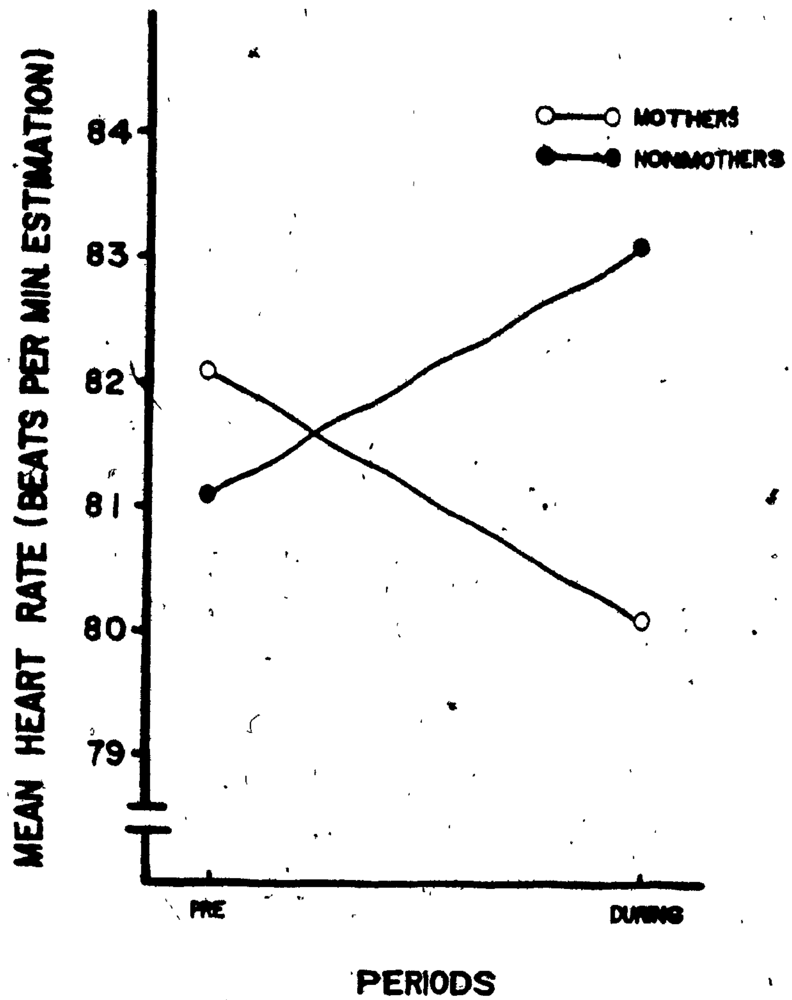

Figure 4. Supplementary Analysis: Interaction of group by period for mean HRM (beats per min estimation).

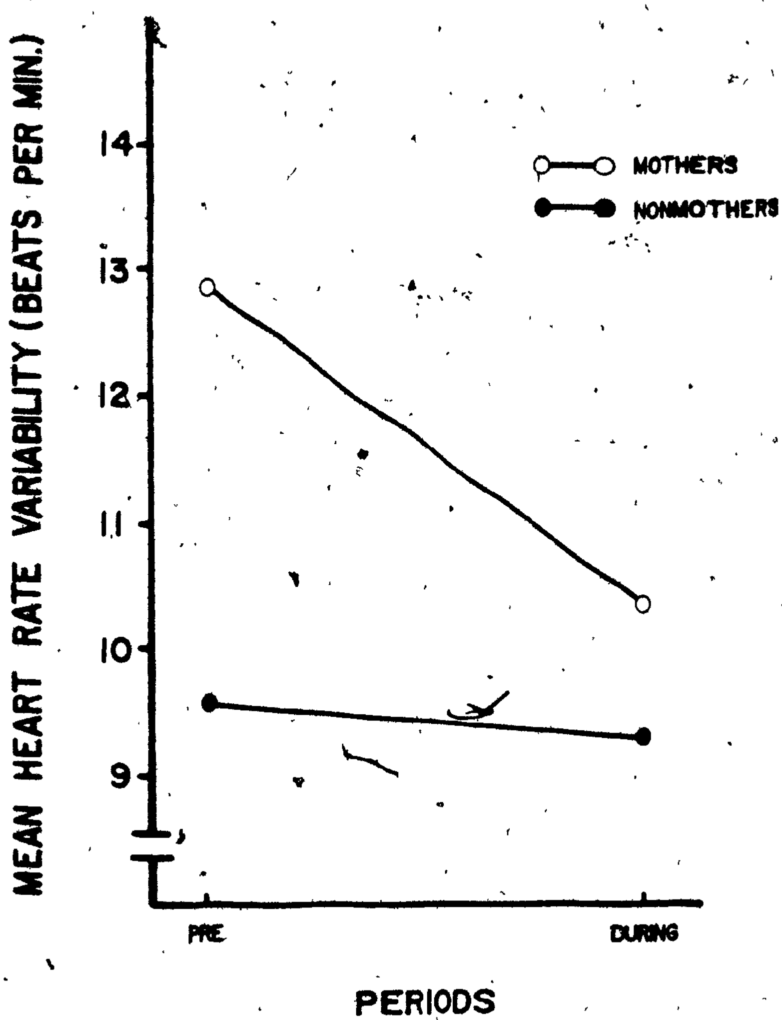

Figure 5. Supplementary Analysis: Interaction of group by period for mean HRV (beats per min).

ing no change in variability from baseline. A significant difference between the groups was also found in baseline HRV ($p < .01$). A subsequent gain score experience x type of vocalization analysis, however, revealed a main effect of groups which only approached significance at the .06 level.

SCL. A significant main effect of vocalization, $F(3,42) = 3.59$, $p < .02$ was obtained on SCL. Scheffé tests indicated a significantly higher SCL to Fu cries than to all other vocalizations ($p < .05$).

SBP. The ANOVA of SBP yielded a significant interaction between groups and type of vocalization, $F(3,42) = 3.04$, $p < .04$), which is shown in Figure 6. Scheffé tests indicated that nonmothers' SBP level for the coos and P1 cries were lower than mothers' SBP ($p < .01$ and $p < .05$, respectively). Nonmothers also had a higher SBP level for Fu and P2 cries than for coos ($p < .05$). Unlike the nonmothers, mothers had a similar SBP for all vocalizations. These results, however, are uninterpretable since there was no main effect of period and no groups by period interaction.

Supplementary Analysis: Subjective Measures

The results of the reanalysis of the SAR and the Z and L scales were in general consistent with the overall analyses performed on these measures. The source tables for the ANOVAs are presented in Appendix J and the mean ratings for the SAR and Z and L scales in Appendix H and I.

SAR. Main effects of vocalization, $F(3,42) = 3.06$, $p < .05$, and period, $F(1,14) = 8.60$, $p < .01$ as well as an interaction between vocalization and period, $F(1,14) = 12.74$, $p < .00001$ (Figure 7) were again obtained. Scheffé tests indicated that cries were arousing, while coos were not. SAR increased after all infant cries ($p < .01$) and decreased after the coos ($p < .01$).

Z and L Scales. All eight ANOVAs of the Z and L scales again yielded significant main effects of vocalization: Urgent, $F(3,42) = 52.85$, $p <$

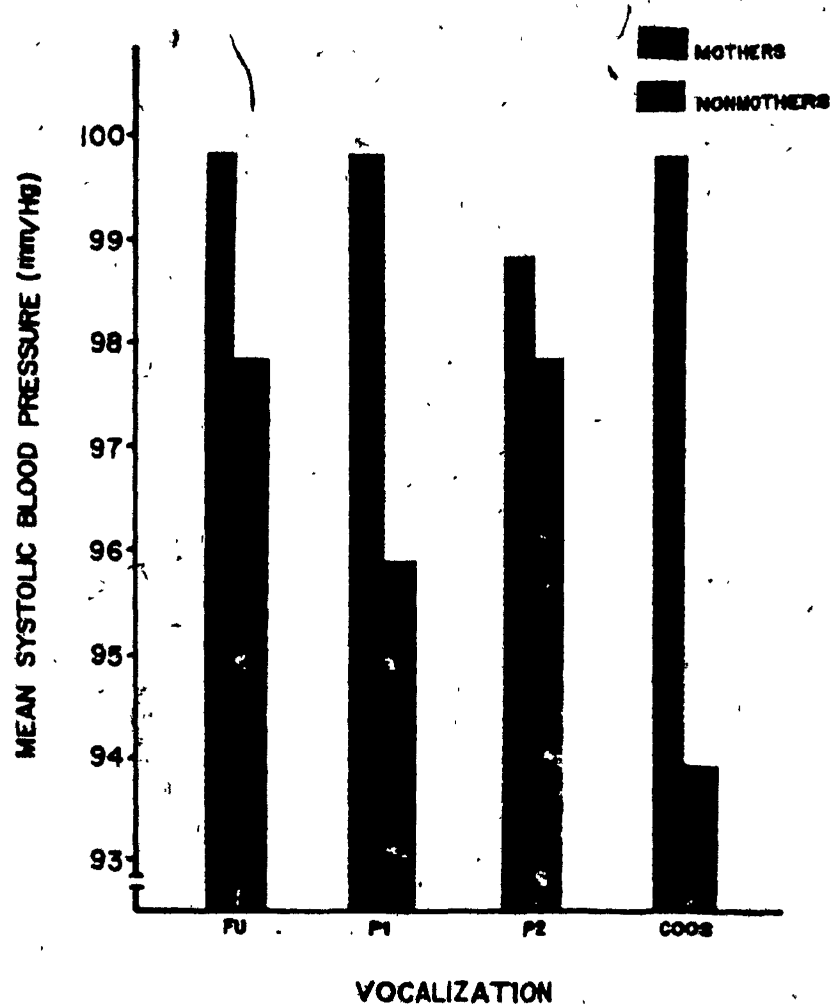

Figure 6. Supplementary Analysis: Interaction of group by vocalization for mean SBP (mm/Hg).

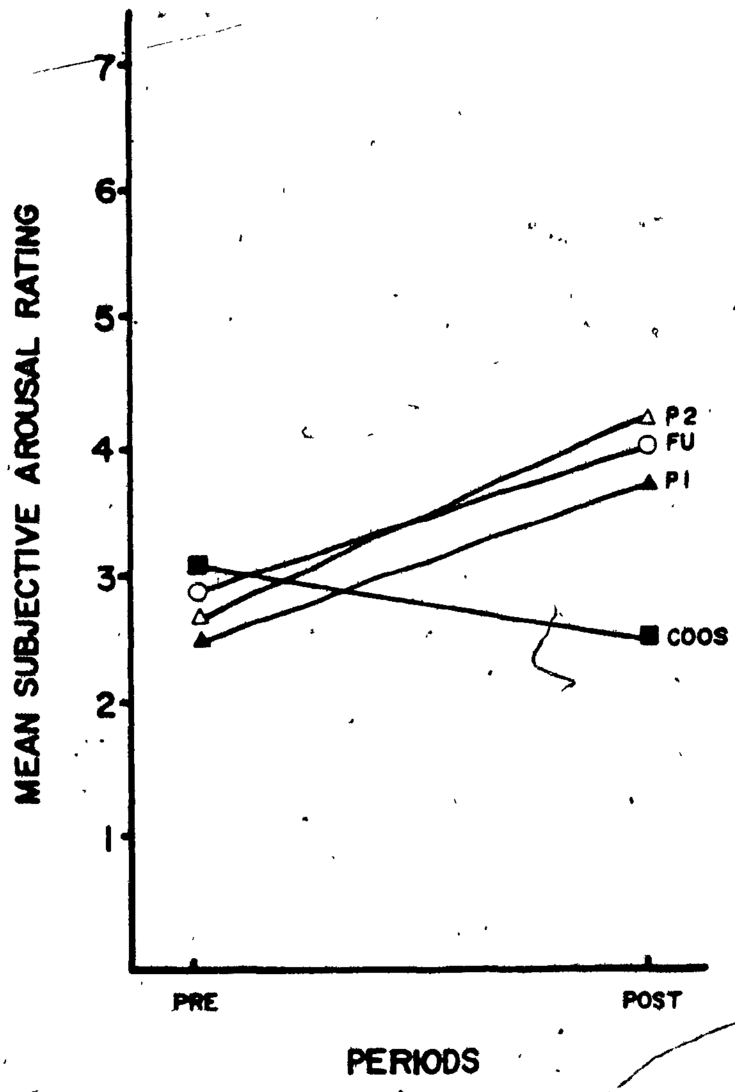

Figure 7. Supplementary Analysis: Interaction of vocalizations by period for mean SAR setting pre and post vocalizations.

.00001; Grating, $F(3,45) = 139.29$, $p < .00001$; Sick, $F(3,42) = 20.86$, $p < .00001$; Arousing, $F(3,42) = 74.97$, $p < .00001$; Piercing, $F(3,42) = 41.66$, $p < .00001$; Discomforting, $F(3,42) = 61.12$, $p < .00001$; Aversive, $F(3,42) = 35.18$, $p < .00001$, and Distressing, $F(3,42) = 46.52$, $p < .00001$. Subsequent Scheffé tests revealed that all cries were rated as moderately aversive, while coos were rated more favourably on all eight scales. Differences that were previously found, however, between the infant cries on the "sickness" and "piercing" scales were not replicated.

Discussion

The results clearly show that although infant coos and cries are at a subjective level perceived very differently, at the autonomic level there was no differentiation. The prediction that infant coos would be perceived as pleasant, and infant cries would be perceived as aversive, was overwhelmingly supported by the data, since cries were rated as moderately aversive while coos were rated favourably on all the Zeskind and Lester scales. The prediction was also strongly supported by the SAR data; the results of the SAR data were consistent with the cry perception data. Although infant cries induced only slight feelings of arousal, this pattern was consistent for all cry types. Coos, on the other hand elicited no change in feelings of arousal. The DBP and SCR data, however, indicated that subjects found both coos and cries arousing, and provided no evidence of any difference in the size of the effect. The effects seen on the HRV and SCL measures simply reflected that subjects attended to all vocalizations. The DBP and SCR findings are reminiscent of the physiological response pattern shown by child abusers in a study by Frodi and Lamb (1980). Frodi and Lamb investigated child abusers' and nonabusers' responses to infant cries and smiles (smiles coupled with audible coos), and found that while the response pattern of nonabusers was the same as that obtained by Frodi et al. (1978a), the abusers responded with physiological arousal to the smiling as well as to the crying infant. The authors interpreted these findings as an indication that child abusers appear to find any social elicitations aversive.

The results of the present research, suggest that increased autonomic arousal elicited by infant crying may not necessarily reflect aversion. This finding has important implications for the body of research investigating adult response to infant crying through subjective as well as physiological measures. As pointed out earlier, most studies have not incorporated audiotapes of infant vocalizations as control stimuli; nevertheless increases in certain physiological indices (DBP, HR, and SC) thought to reflect emotional arousal and aversion in response to infant cries, have been interpreted as evidence that the cries are perceived as aversive (Frodi et al., 1978a; Frodi et al., 1978b). It seems reasonable to speculate, however, that while increases in diastolic blood pressure in the presence of extremely aversive stimuli might be interpreted as an index of "aversion", "anger", or "disposition to aggress", increases in diastolic blood pressure in the present context may be merely reflecting emotional arousal in general. This finding suggests that without appropriate control stimuli, interpreting physiological responses to infant cries as evidence of their aversiveness is not warranted. The results also suggest that the subjective arousal level measure was not a sensitive index of general arousal, since there was no relationship between the results of this measure and the results of the autonomic measures. The relationship found between this scale and the Zeskind and Lester scales, however, suggests that the arousal level scale may be accurately reflecting perceptions of the vocalizations.

The prediction that preterm infant cries recorded at 44 weeks postconceptual age would be perceived as more aversive than cries of fullterm newborns was not supported. Infant cries did not have any differential effect on the autonomic indices, nor were there differences in subjective arousal level as a function of type of infant cry. These findings, while consistent with the finding of Bryan (Note 1), were inconsistent with those of Frodi et al. (1978b), who previously reported that the cry and appearance of a premature infant elicited self reported feelings of aversion, as well as a much greater increase in skin conductance amplitude, heartrate acceleration, and diastolic blood pressure, than the cry and appearance of a fullterm infant. It is important to note, however, that the findings of Frodi et al. are based on the cry and appearance of one preterm infant. Perhaps the phenomenon being investigated is a characteristic unique to some preterm infants.

While fullterm newborn cries and cries of the more mature preterm infant were rated similarly on all eight scales, the cries of these same preterm infants recorded at 38 weeks of age were rated as the least "sick" and the least "piercing". This latter finding provided some support for the prediction that the less mature preterm cries would be perceived as less aversive than the more mature preterm cries. Moreover, the fact that cries of the more mature preterm infants and cries of fullterm newborns were rated equally aversive suggests that, although with maturation of the preterm infant the aversive cry characteristics appear to develop, the cry loses its distinctive features. The fact that the younger preterm infant cries were perceived as the most "healthy" did not support the prediction made earlier that these cries would be perceived as "sick". This finding, however, may reflect the fact that preterm infants even at time of discharge from hospital, when these infants are ostensibly healthy, have difficulty coordinating a fullblown cry. Ferber and Wolff (cited in Boukydis, Note 3) have reported evidence of the young preterm infant's inability to coordinate a fullblown cry. Because its cries are weaker and have less impact on the adult listener, the infant signal may be misinterpreted, and may be a weaker elicitor of caregiving behavior in adults. The finding that cries of the less mature preterm infant had the least impact on adult listeners, is reminiscent of the findings of Freudenberg et al. (1978), who reported that the cries of the infants with Down's Syndrome were less attention-getting than the cries of normal infants. If human infants have evolved the most effective cry over the course of human evolution, as has been suggested (Freudenberg et al., 1978), there would be no logical reason to expect cries of young preterm infants to have the same adaptive value as the cries of more mature preterm infants and fullterm newborns, because the energy invested in raising an "abnormal infant" is biologically wasted.

Failure to find differences between different cry types in the present study may be strictly a function of the experimental manipulations performed coupled with variables other than prematurity. Friedman et al. (Note 2) have reported that the amount of neonatal medical risk the preterm infant suffered appeared to be related to the aversiveness of the cry. The preterm infants from whom cries were recorded in the present study were being nursed in an intensive care unit of high quality; this may have reduced the risk status of the infants. On the other hand, because the research paradigm employed was a modification of the traditional designs typically used, this may have influenced the results somewhat. There was undoubtedly a marked difference between ratings of infant cries and coos on the Zeskind and Lester scales, as well as a marked difference in subjective arousal level settings. Perhaps the strong contrast in these vocalizations served to mask further differences that may have been detected among infant cries.

The prediction that all effects would be stronger in nonmothers than mothers was not supported, nor was there any support for the prediction that mothers would be relatively more sensitive to the "sickness" and "urgency" of cries of the less mature preterm infants. Mothers and nonmothers responded similarly on all measures to the infant vocalizations. This finding is contrary to the findings of Boukydis (1980), Zeskind and Lester (1978), Zeskind (1980), and Bryan (Note 1), but appears to be consistent with the findings of Freudenberg et al. (1978) who found that subjects' experience with infants did not affect their ratings. It is important to note, however, that "experience" in the Freudenberg et al. study was not well defined, since there was no specific mention of parental experience, but rather, amount of experience with infants. It seems reasonable, however, to speculate that maternal experience should alter the perception of infant cries and that failure to find an effect may be a function of a number of confounds. Although there was a wide disparity in the ages of the infants of mothers in the total sample, it is interesting to note that on examination of mothers of only relatively young infants matched with nonmothers of comparable ages an effect of maternal experience did emerge. The heartrate (beats per min) estimation) data indicated that nonmothers responded to the vocalizations with a defensive type of reaction, while mothers merely attended to them.

This finding, however, must be interpreted with caution. The response pattern obtained was not specific to cries, but was elicited by coos as well. More important, analysis of the heartrate (beats per min estimation) data for the total sample of 16 mothers and 16 nonmothers revealed no significant findings. Inspection of the means before and during the vocalizations, moreover, indicated that whereas the total sample of mothers in general responded with a similar deceleration, the nonmothers responded with negligible increase in heartrate. Thus it appears that this finding emerged as a result of eliminating a group of nonmothers. Since the older subjects were not represented in this group of eight mothers and eight nonmothers, it appears that the younger nonmothers responded with marked acceleration to the vocalizations. This finding may simply reflect sampling error and not a legitimate age effect.

In conclusion, the results bore no support for any uniquely aversive quality to the preterm infant's cry. This finding suggests that caution be taken in making generalizations about the aversiveness of preterm infant cries. Previous research investigating the characteristics of the cries of infants at risk suggests that the medical-risk status of the infant may be implicated in the aversiveness of the pain cry. Since caregivers are most frequently confronted with the standard cries of infants, it is important to document how these cries are perceived. Therefore, a study employing both the standard and the pain cries of preterm and fullterm infants of different medical-risk status, may provide a more sensitive test of the effect of these variables. In addition, further research that examined the responses of mothers of relatively young infants as well as the responses of mothers of older infants to infant crying seems warranted. It is also important that studies employing psychophysiological indices incorporate pleasant audible vocalizations of infants as control stimuli in order to facilitate legitimate interpretation of the data. Finally, further research is called for to determine the physiological measure that may be most sensitive in research investigating the effect of infant cries on adult listeners.

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Appendix A

Zeskind and Lester Rating Scales

THE VOCALIZATION WAS

1	2	3	4	5	6	7
URGENT						NOT URGENT

1	2	3	4	5	6	7
PLEASING						GRATING

1	2	3	4	5	6	7
SICK						HEALTHY

1	2	3	4	5	6	7
SOOTHING						AROUSING

1	2	3	4	5	6	7
PIERCING						NOT PIERCING

1	2	3	4	5	6	7
COMFORTING						DISCOMFORTING

1	2	3	4	5	6	7
AVERSIVE						NON-AVERSIVE

1	2	3	4	5	6	7
NOT DISTRESSING						DISTRESSING

Appendix B

Subject Information Questionnaire

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 C

Taped Instructions

Taped Instructions

All instructions will be communicated to you over the headphones. You are going to hear vocalizations from 24 infants. This will consist of the cries of 18 infants, as well as the coos and babbles of six infants. These vocalizations will be presented to you in four blocks, that is, the six coos and babbles will constitute one block, while the 18 cries will be divided into three blocks of six cries each. Each vocalization you hear will be 30 sec long, and each vocalization will be separated from the next by a 1 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. After each block of six vocalizations there will be a period of approximately 5 min during which time you should try to relax. At the end of this rest period the next set of vocalizations will be heard. Again, you will be asked to rate each sound on all eight different rating scales, during the minute of silence following presentation of each sound. This procedure will be repeated until you have completed four blocks of six vocalizations each, and have rated a total of 24 sounds 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 block of six vocalizations 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. Your blood pressure will be measured manually before and after each block of vocalizations. 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. I will now take your blood pressure. (2 min Pause) After each infant cry 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 lets 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 minute of silence following each sound, use that minute to rate the sound you have just heard.

(After rating of sound number 2) Please indicate your level of arousal now by again turning the knob below your right hand. (Immediately after experimenter takes BP) 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. Let us review the instructions once again; the center light on the panel in front of you is now turned on. 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. Remember, the center light in front of you is your reference point for your level of arousal against which you will compare any changes in arousing during the session. Please indicate your level of arousal now, always finishing off by bringing it back to the center position.

Appendix D

Means and Standard Deviations for Blood Pressure Measures

Table A

SBP (mm/Hg) Means and Standard Deviations for total sample

	Group					
	Mothers		Nonmothers		Mean	
Period	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Pre						
Fu	99.50	10.0	96.58	11.7	98.04	12.7
P_1	97.33	13.2	97.04	10.5	97.18	12.0
P_2	99.42	9.4	96.29	12.0	97.85	12.9
Coos	98.29	12.2	95.29	11.8	96.79	13.9
Pre Means	98.63	12.3	96.30	11.7	97.46	13.0
Post						
Fu	98.96	12.5	97.87	12.6	98.41	12.4
P_1	98.54	11.2	97.12	10.3	97.83	10.9
P_2	98.75	11.0	96.37	11.9	97.56	12.5
Coos	99.09	10.2	93.85	12.0	96.46	17.8
Post Means	98.83	10.8	96.30	15.2	97.56	14.2
Group Means	98.73	11.2	96.30	13.0		

Table B

DBP (mm/Hg) Means and Standard Deviations for total sample

	Group					
	Mothers		Nonmothers		Mean	
Period	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Pre						
Fu	64.04	7.9	61.54	12.5	62.79	11.5
P_1	64.00	7.0	59.48	11.2	61.74	14.0
P_2	63.46	7.3	60.62	12.6	62.04	11.7
Coos	62.50	7.0	61.42	11.7	61.96	9.3
Pre Means	63.50	7.6	60.76	12.6	62.13	11.7
Post						
Fu	65.17	9.0	62.29	13.0	63.73	12.8
P_1	64.44	7.8	61.08	10.3	62.76	11.7
P_2	64.00	6.0	62.04	12.8	63.02	10.0
Coos	64.02	6.0	59.92	12.1	61.97	13.0
Post Means	64.41	7.3	61.33	12.9	62.87	12.2
Group Means	63.95	7.4	61.04	12.4		

Table C

SBP (mm/Hg) Means and Standard Deviations for subgroups used in supplementary analysis

	Group					
	Mothers		Nonmothers		Mean	
Period	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Pre						
Fu	100.00	8.6	97.25	12.3	98.62	12.1
P_1	99.33	10.6	95.50	12.1	97.41	14.8
P_2	99.83	8.6	97.75	11.9	98.79	11.0
Coos	99.17	13.6	94.83	11.9	97.00	17.2
Pre Means	99.58	10.1	96.33	14.1	97.95	14.4
Post						
Fu	99.91	12.2	98.58	13.4	99.24	12.8
P_1	100.67	9.1	96.17	11.5	98.42	15.2
P_2	97.75	11.8	97.67	11.6	97.71	11.3
Coos	100.58	10.8	92.46	13.0	96.52	28.5
Post Means	99.73	13.0	96.22	21.1	97.97	19.7
Group Means	99.65	11.2	96.27	17.0		

Table D

DBP (mm/Hg) Means and Standard Deviations for subgroups used in supplementary analysis

	Group					
	Mothers		Nonmothers		Mean	
Period	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Pre						
Fu	63.83	7.9	59.75	14.0	61.79	14.9
P_1	64.50	8.1	57.75	11.9	61.12	21.4
P_2	64.91	8.5	57.92	13.4	61.41	23.2
Coos	63.58	9.1	59.08	12.8	61.33	15.8
Pre Means	63.58	8.5	58.62	13.6	61.41	18.7
Post						
Fu	65.50	8.7	60.75	14.2	63.12	16.9
P_1	66.17	7.2	59.33	9.9	62.75	20.3
P_2	64.17	6.9	59.75	13.4	61.96	14.9
Coos	64.79	7.4	59.00	12.7	61.89	18.4
Post Means	65.16	8.2	59.71	12.7	62.43	17.8
Group Means	64.68	8.3	59.16	13.0		

Appendix E

Means and Standard Deviations for Heartrate Measures

Table A

HRM (beats per min estimation), Means and Standard Deviations for total sample

Period	Mothers $\bar{X}$	Mothers SD	Nonmothers $\bar{X}$	Nonmothers SD	Mean $\bar{X}$	Mean SD
Pre						
Fu	82.38	10.1	81.34	9.7	81.86	9.9
P_1	81.68	7.0	83.64	11.4	82.16	9.1
P_2	81.48	9.5	84.04	9.2	82.76	10.7
Coos	80.82	11.8	82.24	8.9	81.53	10.5
Pre Means	81.59	9.7	82.56	11.4	82.08	10.4
During						
Fu	80.93	11.0	83.06	8.5	81.99	10.6
P_1	81.37	9.4	83.31	8.9	82.34	9.8
P_2	81.16	10.7	83.32	8.6	82.24	10.5
Coos	79.97	10.9	82.10	9.9	81.03	11.2
During Means	80.86	10.5	82.95	9.0	81.90	10.6
Group Means	81.22	9.9	82.75	9.9		

Table B

HRV (beats per min) Means and Standard Deviations for total sample

Period	Mothers $\bar{X}$	Mothers SD	Nonmothers $\bar{X}$	Nonmothers SD	Mean $\bar{X}$	Mean SD
Pre						
Fu	12.37	4.8	10.49	3.8	11.43	5.0
P_1	12.58	4.7	11.24	5.9	11.91	5.6
P_2	12.38	6.4	11.87	5.7	12.12	5.9
Coos	11.84	4.0	11.97	5.3	11.90	4.5
Pre Means	12.29	4.9	11.39	5.5	11.84	5.2
During						
Fu	9.84	3.[illegible]	10.39	3.4	10.11	3.3
P_1	10.76	4.0	10.59	3.5	10.67	3.6
P_2	10.64	4.1	10.24	3.7	10.44	3.8
Coos	10.58	3.0	9.77	3.4	10.17	3.3
During Means	10.45	3.6	10.25	3.5	10.35	3.4
Group Means	11.37	5.0	10.82	4.7		

Table C

HRM (beats per min estimation) Means and Standard Deviations for subgroups used in supplementary analysis.

	Group					
	Mothers		Nonmothers		Mean	
Period	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Pre						
Fu	82.79	11.1	80.02	9.6	81.40	12.0
P_1	81.48	8.7	80.31	11.3	80.89	10.0
P_2	82.96	11.8	82.42	9.8	82.69	10.5
Coos	80.29	15.3	80.41	9.0	80.35	11.8
Pre Means	81.88	13.3	80.79	11.1	81.33	12.1
During						
Fu	79.62	13.3	83.24	7.8	81.43	13.6
P_1	80.61	11.4	83.02	8.3	81.81	11.0
P_2	80.63	12.3	83.40	7.6	82.01	11.6
Coos	78.38	13.4	82.36	10.6	80.37	15.7
During Means	79.81	13.5	83.00	8.4	81.40	13.2
Group Means	80.84	14.1	81.89	10.7		

Table D

HRV (beats per min) Means and Standard Deviations for subgroups used in supplementary analysis

	Group					
	Mothers		Nonmothers		Mean	
Period	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Pre						
Fu	13.62	5.7	9.98	2.0	11.80	7.1
P_1	12.19	5.3	8.81	3.8	10.86	7.5
P_2	13.06	8.7	9.69	3.2	11.37	8.7
Coos	12.67	4.5	9.75	2.5	11.21	5.6
Pre Means	12.88	6.3	9.56	3.1	11.22	7.4
During						
Fu	10.06	4.5	9.65	2.0	9.85	3.2
P_1	10.98	5.5	9.80	2.5	10.39	4.2
P_2	10.76	5.6	9.49	1.9	10.12	4.0
Coos	9.96	3.6	8.54	3.1	9.25	3.3
During Means	10.44	4.9	9.37	2.5	9.90	3.9
Group Means	11.66	6.9	9.46	2.7		

Appendix F

Means and Standard Deviations for Skin Conductance Measures

Table A

SCL (micromhos) Means and Standard Deviations for total sample

	Group					
	Mothers		Nonmothers		Mean	
Period	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Pre						
Fu	4.57	3.5	4.18	2.0	4.37	2.7
P_1	4.58	3.4	3.85	2.0	4.21	2.8
P_2	4.38	3.2	3.84	1.8	4.11	2.5
Coos	4.25	3.3	3.98	1.7	4.11	2.4
Pre Means	4.44	3.2	3.96	1.8	4.12	2.5
During						
Fu	4.94	3.7	4.38	2.1	4.66	2.9
P_1	4.87	3.6	4.38	1.7	4.62	2.6
P_2	4.81	3.1	4.15	1.5	4.48	2.3
Coos	4.91	3.5	4.54	1.8	4.72	2.6
During Means	4.88	3.3	4.36	1.7	4.62	2.5
Group Means	4.66	3.2	4.16	1.7		

Table B

SCR Means and Standard Deviations for total sample

	Group					
	Mothers		Nonmothers		Mean	
Period	X̄	SD	X̄	SD	X̄	SD
Pre						
Fu	0.93	1.6	0.44	.7	0.68	1.2
P_1	0.62	1.1	0.19	.4	0.40	.8
P_2	0.43	1.0	0.12	.3	0.27	.65
Coos	0.37	1.0	0.50	1.1	0.43	1.0
Pre Means	0.59	1.2	0.31	.64	0.45	.91
During						
Fu	0.90	1.0	0.68	.8	0.79	.9
P_1	0.80	1.1	0.50	.4	0.65	.75
P_2	1.15	1.4	0.71	.6	0.92	1.0
Coos	0.99	1.1	0.78	.7	0.88	.90
During Means	0.96	1.1	0.67	.61	0.81	.85
Group Means	0.77	1.1	0.49	.64		

Table C

SCL (micromhos) Means and Standard Deviations for subgroups used in supplementary analysis

	Group					
	Mothers		Nonmothers		Mean	
Period	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Pre						
Fu	4.28	2.6	5.48	1.8	4.88	2.5
P_1	4.16	2.5	4.92	1.6	4.54	2.1
P_2	4.02	2.5	4.87	1.5	4.44	2.1
Coos	3.79	2.5	4.94	1.3	4.36	2.2
Pre Means	4.06	1.2	5.05	1.6	4.55	1.6
During						
Fu	4.63	2.7	5.72	1.7	5.17	2.4
P_1	4.39	2.5	5.33	1.3	4.86	2.1
P_2	4.56	2.5	4.75	1.3	4.65	1.8
Coos	4.36	2.7	5.59	1.3	4.97	2.3
During Means	4.48	2.5	5.35	1.6	4.91	2.2
Group Means	4.27	1.8	5.20	1.6		

Table D

SCR Means and Standard Deviations for subgroups used in supplementary analysis

Period	Group: Mothers $\bar{X}$	Mothers [illegible]	Nonmothers $\bar{X}$	Nonmothers SD	Mean $\bar{X}$	Mean SD
Pre						
Fu	.75	1.2	.75	.9	.75	1.0
P_1	.37	1.1	.12	.3	.24	.7
P_2	.25	.5	.25	.5	.25	.5
Coos	.12	.3	1.0	1.5	.56	1.1
Pre Means	.37	.8	.53	1.0	.45	.9
During						
Fu	.73	.9	.71	.7	.72	.8
P_1	.48	.7	.48	.3	.48	.5
P_2	.86	.9	.63	.6	.74	.7
Coos	.76	.8	.80	[illegible]	.78	.7
During Means	.71	.8	.65	.5	.68	.6
Group Means	.54	.8	.59	.7		

Appendix G

Source Tables for Analyses of Variance of Psychophysiological Measures

Table A

Analysis of variance of SBP (mm/Hg) as a function of maternal experience, type of vocalization, and periods.

Source	SS	df	MS	F	p
Groups (G)	453.96	1	453.96	.48	
$Error_b$	28470.90	30	949.03		
Vocalizations (V)	95.59	3	31.86	2.24	<.09
G x V	52.63	3	17.54	1.23	
$Error_1$	1280.66	90	14.23		
Periods (P)	1.09	1	1.09	.24	
G x P	1.28	1	1.28	.28	
$Error_2$	135.29	30	4.51		
V x P	5.47	3	1.82	.20	
G x V x P	36.64	3	12.21	1.35	
$Error_3$	815.05	90	9.06		

Table B

Analysis of variance of DBP (mm/Hg) as a function of maternal experience, type of vocalization, and periods.

Source	SS	df	MS	F	p
Groups	539.69	1	539.69	.73	
$Error_b$	22127.60	30	737.59		
Vocalizations (V)	59.25	3	19.75	1.89	
G x V	23.37	3	7.79	.74	
$Error_1$	942.02	90	10.47		
Periods (P)	34.88	1	34.88	6.47	$<.02$
G x P	2.05	1	2.05	.38	
$Error_2$	161.83	30	5.39		
V x P	11.30	3	3.77	.48	
G x V X P	43.80	3	14.60	1.87	
$Error_3$	703.76	90	7.82		

Table C

Analysis of variance of HRM (beats per min. estimation) as a function of maternal experience, type of vocalization, and periods

Source	SS	df	MS	F	p
Groups (G)	153.60	1	153.60	.22	
$Error_b$	20731.20	30	691.04		
Vocalizations (V)	53.40	3	17.80	1.39	
G x V	24.90	3	8.30	.65	
$Error_1$	1155.57	90	12.84		
Periods (P)	2.70	1	2.70	.14	
G x P	21.45	1	21.45	1.14	
$Error_2$	565.90	30	18.86		
V x P	6.56	3	2.18	.35	
G x V x P	29.95	3	9.98	1.60	
$Error_3$	560.77	90	6.23		

Table D

Analysis of variance of HRV (beats per min) as a function of maternal experience, type of vocalization, and periods.

Source	*SS*	*df*	*MS*	*F*	*p*
Groups (G)	19.97	1	19.97	.17	
$Error_b$	3486.52	30	116.21		
Vocalizations (V)	11.86	3	3.95	.69	
G x V	1.77	3	.59	.10	
$Error_1$	515.55	90	5.73		
Periods (P)	145.65	1	145.65	16.03	<.001
G x P	7.87	1	7.87	.87	
$Error_2$	272.53	30	9.08		
V x P	3.04	3	1.01	.20	
G x V x P	25.05	3	8.35	1.67	
$Error_3$	450.87	90	5.01		

Table E

Analysis of variance of SCL (micromhos) as a function of maternal experience, type of vocalization, and periods.

Source	SS	df	MS	F	p
Groups (G)	16.45	1	16.45	.28	
$Error_b$	1743.62	30	58.12		
Vocalizations (V)	1.66	3	.55	1.24	
G x V	.89	3	.29	.66	
$Error_1$	40.12	90	.44		
Periods (P)	10.93	1	10.93	24.59	<.00001
G x P	.37	1	.37	.84	
$Error_2$	13.33	30	.44		
V x P	.80	3	.26	1.83	
G x V x P	.42	3	.14	.97	
$Error_3$	13.06	90	.14		

Table F

Analysis of variance of SCR as a function of maternal experience, type of vocalization, and periods.

Source	SS	df	MS	F	p
Groups (G)	5.40	1	5.40	1.16	
$Error_b$	139.93	30	4.66		
Vocalizations (V)	1.52	3	.51	1.03	
G x V	1.40	3	.47	.95	
$Error_1$	44.03	90	.49		
Periods (P)	7.42	1	7.42	10.94	<.001
G x P	.56	1	.56	.83	
$Error_2$	20.36	30	.68		
V x P	2.77	3	.92	2.74	<.05
G x V x P	.81	3	.27	.80	
$Error_3$	30.41	90	.34		

Table G

Analysis of variance of SCR gain scores as a function of maternal experience, and type of vocalization.

Source	SS	df	MS	F	p
Groups (G)	.38	1	.38	.27	
$Error_b$	41.24	30	1.37		
Vocalizations (V)	4.45	3	1.48	2.22	<.09
G x V	2.26	3	.75	1.13	
Error	60.23	90	.67		

Appendix H

Means, Standard Deviations, and Source Table for Analysis of Variance of Subjective Arousal Settings

Table A

SAR Means and Standard Deviations for total sample

	Group					
	Mothers		Nonmothers		Mean	
Period	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Pre						
Fu	3.4	1.6	2.4	1.0	2.9	1.5
P_1	3.0	1.1	2.4	1.2	2.7	1.2
P_2	3.0	1.1	2.6	1.1	2.8	1.1
Coos	3.1	1.2	2.9	1.2	3.0	1.2
Pre Means	3.1	1.2	2.6	1.1	2.8	1.2
Post						
Fu	4.4	1.3	3.8	1.7	4.1	1.5
P_1	4.1	1.4	3.6	1.4	3.8	1.4
P_2	4.7	1.1	3.9	1.6	4.3	1.5
Coos	2.7	1.5	2.6	1.4	2.6	1.4
Post Means	4.0	2.3	3.5	1.9	3.7	2.1
Group Means	3.5	1.9	3.0	1.7		

Table B

SAR Means and Standard Deivations for subgroups used in supplementary analysis

Period	Group: Mothers $\bar{X}$	Mothers SD	Nonmothers $\bar{X}$	Nonmothers SD	Mean $\bar{X}$	Mean SD
Pre						
Fu	3.2	1.9	2.6	1.2	2.9	1.6
P_1	3.1	1.2	2.4	1.2	2.7	1.3
P_2	3.2	1.5	3.0	1.3	3.1	1.4
Coos	3.5	1.6	3.2	1.[illegible]	3.3	1.4
Pre Means	3.2	1.5	2.8	1.3	3.0	1.4
Post						
Fu	4.1	1.5	3.9	1.5	4.0	1.5
P_1	3.8	1.6	3.7	1.0	3.7	1.3
P_2	4.6	1.5	4.4	1.2	4.5	1.3
Coos	2.5	1.8	2.5	.5	2.5	1.1
Post Means	3.7	2.6	3.6	1.9	3.6	2.4
Group Means	3.4	1.9	3.2	1.7		

Table C

Analysis of variance of SAR as a function of maternal experience, type of vocalization, and periods.

Source	SS	df	MS	F	p
Groups (G)	17.01	1	17.01	2.19	
Error$_b$	233.34	30	7.78		
Vocalizations (V)	20.83	3	6.94	6.70	<.001
G x V	3.26	3	1.08	1.05	
Error$_1$	93.16	90	1.03		
Periods (P)	52.56	1	52.56	33.82	<.00001
G x P	.62	1	.62	.40	
Error$_2$	46.62	30	1.55		
V x P	31.03	3	10.34	15.17	<.00001
G x V x P	1.34	3	.45	.66	
Error$_3$	61.37	90	.68		

Appendix I

Means, Standard Deviations, and Source Tables for Analyses of Variance of Vocalization Ratings

Table A

Means and Standard Deviations for vocalization ratings of total sample

Scale		Pu M[a]	Pu C[b]	P$_1$ M	P$_1$ C	P$_2$ M	P$_2$ C	Coos M	Coos C
Urgent		5.3	5.5	4.9	5.0	5.1	5.5	1.7	1.9
	S.D.	.7	1.0	1.0	.8	1.0	.8	1.2	.8
Grating		5.4	5.3	5.3	5.3	5.3	5.7	1.8	.8
	S.D.	.8	.6	.8	.6	.9	.7	.8	.8
Sick		4.2	4.0	3.3	3.2	4.0	3.8	1.7	1.8
	S.D.	.9	1.2	1.1	1.2	1.2	1.3	1.0	1.1
Arousing		5.6	5.5	5.4	5.3	5.5	5.6	2.3	2.7
	S.D.	.6	.7	.7	.6	.7	.7	1.0	1.1
Piercing		5.1	5.3	4.2	4.6	4.8	5.3	2.0	2.1
	S.D.	1.0	.9	1.2	1.0	1.1	.9	1.0	1.2
Discomforting		5.7	5.5	5.3	5.2	5.5	5.6	2.0	2.3
	S.D.	.6	.9	.8	.6	.7	.7	.9	1.1
Aversive		4.6	5.1	4.2	4.7	4.5	5.2	1.8	1.8
	S.D.	1.3	.9	1.1	1.2	1.1	1.1	1.0	1.0
Distressing		5.3	5.0	4.8	4.6	5.1	5.1	1.4	1.7
	S.D.	.7	1.0	[illegible]	1.1	1.0	1.0	.6	1.0

[a]M = mothers

[b]C = nonmothers

Table B

Mean and Standard Deviations for vocalization ratings of subgroups used in supplementary analysis

		Vocalizations							
		Fu		P_1		P_2		Coos	
Scale		M[a]	C[b]	M	C	M	C	M	C
Urgent		5.5	5.5	4.7	5.2	5.3	5.7	1.9	2.1
	S.D.	.8	.9	1.1	.8	.9	.8	1.3	1.2
Grating		5.7	5.7	5.2	5.4	5.4	5.7	2.1	2.0
	S.D.	.9	.5	1.0	.5	.8	.6	.8	.9
Sick		4.9	3.9	3.8	3.1	4.2	4.0	2.1	1.5
	S.D.	.7	1.2	1.5	1.4	1.4	1.5	1.2	.5
Arousing		5.7	5.5	5.5	5.2	5.5	5.7	2.5	2.7
	S.D.	.8	.6	1.0	.5	.7	.8	.9	1.0
Piercing		5.2	5.4	4.2	5.0	5.0	5.4	1.9	2.4
	S.D.	1.0	.7	1.5	.7	1.1	1.0	.5	1.2
Discomforting		6.0	5.5	5.6	5.2	5.7	5.7	2.3	2.5
	S.D.	.5	.7	1.0	.4	.7	.8	.9	1.1
Aversive		4.9	5.4	4.4	5.1	4.5	5.5	1.9	2.0
	S.D.	1.5	.9	1.4	1.1	1.2	1.2	1.0	1.0
Distressing		5.7	5.0	5.0	4.7	5.4	5.3	1.6	1.8
	S.D.	.7	.9	1.3	.8	1.1	.9	.7	1.1

[a]M = mothers

[b]C = nonmothers

Table C

Analysis of variance of rating scales as a function of maternal experience and type of vocalization

Scale	Source	SS	df	MS	F	p
Urgent	Groups (G)	2.00	1	2.00	1.20	
	$Error_b$	49.97	30	1.66		
	Vocalizations (V)	241.03	3	80.34	105.51	<.00001
	G x V	.44	4	.14	.19	
	Error	68.53	90	.76		
Grating	Groups (G)	.78	1	.78	.59	
	$Error_b$	39.94	30	1.33		
	Vocalizations (V)	312.09	3	104.03	252.62	<.00001
	G x V	.84	3	.28	.68	
	Error	37.06	90	.41		
Sick	Groups (G)	1.76	1	1.76	.71	
	$Error_b$	74.61	30	2.49		
	Vocalizations (V)	97.65	3	32.55	37.46	<.00001
	G x V	.40	3	.13	.15	
	Error	78.20	90	.87		
Arousing	Groups (G)	.78	1	.78	.64	
	$Error_b$	36.42	30	1.21		
	Vocalizations (V)	211.96	3	70.65	150.01	<.00001
	G x V	2.40	3	.80	1.70	
	Error	42.39	90	.47		

Table C

(Continued)

Scale	Source	SS	df	MS	F	p
Piercing	Groups (G)	4.88	1	4.88	2.01	
	Error$_b$	72.73	30	2.42		
	Vocalizations (V)	179.96	3	59.99	78.87	<.00001
	G x V	.84	3	.28	.37	
	Error	68.45	90	.76		
Discomforting	Groups (G)	.31	1	.31	.27	
	Error$_b$	34.94	30	1.16		
	Vocalizations (V)	245.53	3	81.84	140.47	<.00001
	G x V	2.03	3	.68	1.16	
	Error	52.44	0	.58		
Aversive	Groups (G)	5.69	1	5.69	2.16	
	Error$_b$	79.23	30	2.64		
	Vocalizations (V)	188.71	3	62.90	75.03	<.00001
	G x V	2.08	3	.69	.83	
	Error	65.45	90	.84		
Distressing	Groups (G)	.50	1	.50	.28	
	Error$_b$	53.72	30	1.79		
	Vocalizations (V)	241.28	3	80.43	106.99	<.00001
	G x V	1.56	3	.52	.69	
	Error	67.66	90	.75		

Appendix J

Analysis of Variance Source Tables for Supplementary Analyses

Table A

Analysis of variance of SBP (mm/Hg) as a function of maternal experience, type of vocalization, and periods.

Source	SS	df	MS	F	p
Groups (G)	366.87	1	366.87	.37	
$Error_b$	13693.30	14	978.10		
Vocalizations (V)	79.95	3	26.65	1.93	
G x V	126.10	3	42.03	3.04	< .04
$Error_1$	580.94	42	13.83		
Periods (P)	.94	1	.94	.14	
G x P	.51	1	.51	.76	
$Error_2$	94.88	14	6.78		
V x P	22.21	3	7.40	.55	
G x V x P	41.08	3	13.69	1.02	
$Error_3$	561.79	42	13.37		

Table B

Analysis of variance of DBP (mm/Hg) as a function of maternal experience, type of vocalization, and periods.

Source	SS	df	MS	F	p
Groups (G)	1017.57	1	1017.57	1.19	
$Error_b$	11928.10	14	852.01		
Vocalizations (V)	23.86	3	7.95	.79	
G x V	16.70	3	5.57	.55	
$Error_1$	420.70	42	10.02		
Periods (P)	25.29	1	25.29	4.59	<.05
G x P	1.03	1	1.03	.19	
$Error_2$	77.16	14	5.51		
V x P	5.99	3	2.00	.19	
G x V x P	15.89	3	5.30	.49	
$Error_3$	448.90	42	10.69		

Table C

Analysis of variance of HRM (beats per min estimation) as a function of experience, type of vocalization, and periods.

Source	SS	df	MS	F	p
Groups (G)	35.38	1	35.38	.41	
$Error_b$	12065.90	14	861.85		
Vocalizations (V)	63.49	3	21.16	1.28	
G x V	12.61	3	4.20	.25	
$Error_1$	696.38	42	16.58		
Periods (P)	.12	1	.12	.54	
G x P	146.85	1	146.85	7.39	<.02
$Error_2$	278.25	14	19.87		
V x P	10.31	3	3.44	.42	
G x V x P	12.39	3	4.13	.50	
$Error_3$	344.10	42	8.19		

Table D

Analysis of variance of HRV (beats per min) as a function of maternal experience, type of vocalization, and periods.

Source	SS	df	MS	F	p
Groups (G)	155.32	1	155.32	1.52	
$Error_b$	1432.16	14	102.30	1.52	
Vocalizations (V)	7.29	3	2.43	.32	
G x V	.26	3	.88	.12	
$Error_1$	317.62	42	7.56		
Periods (P)	56.44	1	56.44	6.22	<.02
G x P	40.50	1	40.50	4.46	<.05
$Error_2$	126.99	14	9.07		
V x P	19.36	3	6.45	1.06	
G x V x P	2.92	3	.97	.16	
$Error_3$	256.55	42	6.11		

Table E

Analysis of variance of HRV gain scores as a function of maternal experience and type of vocalization.

Source	SS	df	MS	F	p
Groups (G)	77.66	1	77.66	4.20	<.06
$Error_b$	258.54	14	18.47		
Vocalizations (V)	37.90	3	12.63	1.06	
G x V	6.37	3	2.12	.18	
Error	501.53	42	11.94		

Table F

Analysis of variance of SCL (micromhos) as a function of maternal experience, type of vocalization, and periods

Source	SS	df	MS	F	p
Groups (G)	26.83	1	26.83	.81	
$Error_b$	463.28	14	33.09		
Vocalizations (V)	4.10	3	1.36	3.59	<.02
G x V	2.19	3	.73	1.92	
$Error_1$	15.97	42	.38		
Periods (P)	3.99	1	3.99	14.90	<.002
G x P	.15	1	.15	.56	
$Error_2$	3.75	14	.27		
V x P	.67	3	.22	1.98	
G x V x P	.76	3	.25	2.23	<.1
$Error_3$	4.77	42	.11		

Table G

Analysis of variance of SCR as a function of maternal experience, type of vocalization, and periods.

Source	SS	df	MS	F	p
Groups (G)	.73	1	.73	.28	
$Error_b$	35.54	14	2.54		
Vocalizations (V)	2.70	3	.90	1.74	
G x V	1.85	3	.62	1.19	
$Error_1$	21.70	42	.52		
Periods (P)	1.32	1	1.32	2.38	<.10
G x P	.38	1	.38	.72	
$Error_2$	7.44	14	.53		
V x P	1.10	3	.37	1.49	
G x V x P	1.25	3	.42	1.69	
$Error_3$	10.35	42	.25		

Table H

Analysis of variance of SAR as a function of maternal experience, type of vocalization, and periods.

Source	SS	df	MS	F	p
Groups (G)	3.12	1	3.12	.39	
$Error_b$	111.87	14	7.99		
Vocalizations (V)	12.81	3	4.27	3.06	<.04
G x V	.56	3	.19	.13	
$Error_1$	58.62	42	1.39		
Period (P)	13.78	1	13.78	8.60	<.01
G x P	.78	1	.78	.49	
$Error_2$	22.44	14	1.60		
V x P	25.53	3	8.51	12.74	<.00001
G x V x P	.41	3	.13	.20	
$Error_3$	28.06	42	.67		

Table I

Analysis of variance of rating scales as a function of maternal experience and type of vocalization

Scale	Source	SS	df	MS	F	p
Urgent	Groups (G)	.14	1	.14	.82	
	$Error_b$	23.84	14	1.70		
	Vocalizations (V)	122.80	3	40.93	52.85	< .00001
	G x V	.92	3	.31	.40	
	Error	32.53	42	.77		
Grating[a]	Vocalizations	154.37	3	51.46	139.29	< .00001
	Error	16.62	45	.37		
Sick	Groups (G)	7.56	1	7.56	2.44	< .1
	$Error_b$	43.37	14	3.10		
	Vocalizations (V)	57.56	3	19.19	20.86	< .00001
	G x V	.31	3	.10	.11	
	Error	38.62	42	.92		
Arousing	Groups (G)	.76	1	.76	.50	
	$Error_b$	21.22	14	1.51		
	Vocalizations (V)	103.92	3	34.64	74.97	< .00001
	G x V	1.92	3	.64	1.39	
	Error	19.41	42	.46		

[a] Group means were identical, hence the ANOVA could not be performed with groups as a factor; scores were collapsed across groups and a one way repeated measures ANOVA performed on the vocalizations.

Table I

(Continued)

Scale	Source	SS	df	MS	F	p
Piercing	Groups (G)	2.25	1	2.25	.96	
	$Error_b$	32.69	14	2.33		
	Vocalizations (V)	93.19	3	31.06	41.66	<.00001
	G x V	.50	3	.17	.22	
	Error	31.31	42	.74		
Discomforting	Groups (G)	1.00	1	1.00	1.04	
	$Error_b$	13.44	14	.96		
	Vocalizations (V)	124.69	3	41.56	61.12	<.00001
	G x V	2.25	3	.75	1.10	
	Error	29.56	42	.68		
Aversive	Groups (G)	5.64	1	5.64	1.67	
	$Error_b$	47.22	14	3.37		
	Vocalizations (V)	104.67	3	34.89	35.18	<.00001
	G x V	1.92	3	.64	.64	
	Error	41.66	42	.99		
Distressing	Groups (G)	1.89	1	1.89	.95	
	$Error_b$	27.72	14	1.98		
	Vocalizations (V)	124.30	3	41.43	46.52	<.00001
	G x V	1.55	3	.51	.58	
	Error	37.41	42	.89		