

DOCUMENT RESUME

ED 129 424

PS 008 825

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 TITLE Mother-Infant Vocal Interaction During Feeding at Six and Nine Months and Its Relationship to Maternal Sensitivity.
 PUB DATE Apr 76
 NOTE 16p.; Paper presented at the Biennial Southeastern Conference on Human Development (4th, Nashville, Tennessee, April 15-17, 1976)
 EDPS PRICE MF-\$0.83 HC-\$1.67 Plus Postage.
 DESCRIPTORS Caucasians; Early Childhood Education; *Infants; *Interaction Process Analysis; Middle Class Mothers; *Mothers; Oral Communication; *Parent Child Relationship; Research; Social Development; *Verbal Communication
 IDENTIFIERS *Infant Feeding; *Maternal Sensitivity

ABSTRACT

This study explored the relationship between maternal sensitivity and the development of mother-infant vocal interaction. Two characteristics of mother and infant vocalizations were assessed at six and nine months in a home feeding situation: (1) the degree of mutual responsiveness, and (2) the affective quality of vocalization. These assessments of vocal interaction were compared with assessments of maternal sensitivity and cooperation made during the same feeding situations. Subjects were 28 middle class mothers and infants, videotaped at home during lunchtime feedings. Five-minute samples of feedings were analyzed according to a mutual responsiveness instrument developed by the author, an affect rating scale designed by Adamson, Tronick, Brazelton, and Als (1975), and maternal sensitivity scales developed by Ainsworth (19691). The most significant and stable relationships found were those comparing mother and infant vocalization with maternal sensitivity. Infants of highly sensitive mothers appeared to rely increasingly on vocalization during feeding to signal states of comfort, hunger, or other needs and desires related to eating. Overall, sensitive mothers did less talking as their infants began to vocalize more. Highly sensitive mothers seemed to allow for reciprocity by adjusting their own vocal stimulation to the vocal production of their babies. Relationships between cooperation and mother-infant vocal interaction were generally weaker than those summarized above. (Author/SB)

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ED129424

Southeastern Conference on Human Development
Nashville, Tennessee
April, 1976
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MOTHER-INFANT VOCAL INTERACTION DURING FEEDING
AT SIX AND NINE MONTHS AND ITS RELATIONSHIP
TO MATERNAL SENSITIVITY

The emergence of reciprocal or mutually responsive exchanges between mother and infant during caregiving and play are of particular interest to investigators who seek to understand the processes by which an individual initially evolves patterns of social interaction or communication (Ainsworth, Bell, and Stayton, 1974; Brazelton, Koslowski, and Main, 1974).

Ainsworth, et al. (1971, 1972), have been especially concerned with identifying those characteristics of mother-infant interaction which are associated with healthy attachment relationships. Of four scales developed by Ainsworth to assess maternal behavior, the scale which most powerfully discriminates among patterns of attachment is that which deals directly with Sensitivity vs. Insensitivity to infant signals. Thus far, Ainsworth and her colleagues have been unsuccessful in isolating variables which reflect individual differences in the group of infants whose attachment is judged to be healthy or secure in a global way. However, it is these babies who appear, as a result of early maternal responsiveness, to be most competent in exploring their environment and in using differentiated modes of communication (Bell and Ainsworth, 1972) at one year of age.

While Ainsworth's studies of mother-infant interaction focus on the maternal contribution, in terms of the promptness and appropriateness of her response to the infant's signals, Brazelton, et al. (1974), Stern (1974),

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Lusk and Lewis (1972), Lewis, Lee, and Painter (1974), and Freedle and Lewis (1971) have investigated the infant's responsiveness to its mother's signals as well. The rhythm or temporal coordination of mother and infant behaviors is also of prime importance in the more tedious type of analyses of specific behaviors which these studies represent. However, in addition to assessing the timing of behaviors, Brazelton and Stern have attempted to record the sequence of certain behaviors, how they cluster together to provide given functions, e.g., regulation of one's level of arousal or excitement. Brazelton has observed that although three-month old babies may vocalize while building up their level or arousal, frequently, they seem to need to start with body activity which accelerates and peaks in a vocalization. Mothers can cut short this vocal interchange by talking too much or can extend it by a brief vocal response. With one exception (Bach, 1974), no attempt has been made to prove the relationship between general assessments of maternal sensitivity and more precise descriptions of both maternal and infant interactive behaviors. Furthermore, little empirical attention has been devoted to the role of development in the emergence of reciprocal interchanges.

The intent of the current study was to explore the relationship between maternal sensitivity and the development of mother-infant vocal interaction during the second half of the baby's first year. Specifically, two characteristics of mother and infant vocalizations were assessed at six and at nine months in a home feeding situation: the degree of mutual temporal responsiveness and the affective quality of vocalizations.

Method

Subjects. The group of subjects consisted of 28 mother-infant pairs from white, middle-class families. Of these pairs, 21 were filmed at six and nine

months, or at six months only, while seven pairs were filmed at nine months only. The six-month subjects consisted of ten males and eleven females ranging in age when first filmed from 25 weeks, 3 days, to 31 weeks, 1 day, with a median age of 26 weeks, 4 days. In this group, there were 17 first-borns, 3 second-borns, and one first-born with an adopted four-year old sibling. The subjects filmed only at nine months included two males and five females whose median age when first filmed was likewise approximately 26 weeks. This latter group contained six first-borns and one second-born. The entire group of subjects was drawn from a listing of mothers from the Minneapolis-St. Paul area who returned interest cards which were sent to the parents of all announced births in the Minneapolis newspaper.

Data Collection. Each subject was visited by a group of male or male and female graduate-student researchers in order to familiarize her with the various persons who would be videotaping her with the baby and to explain the purpose of the study.¹ The mother was told that the research team would be looking at the reactions of normal babies to everyday routine and that she should do merely what she ordinarily does.

The videotaped visits were made at a time convenient to the mother, generally a lunchtime feeding. Entire sequences of bottle or breast and solid food feedings were recorded. However, in an effort to control situational variability, only the solid feeding samples were excerpted for analysis in this study. The samples ranged in length from five to ten minutes, although only five minutes were analyzed in order to compare data collected over a constant period of time. Five-minute segments were selected on the basis of the lack of interference by persons other than the mother or baby and by

non-human noise, e.g., refrigerator, radio, television, etc. At points when it was not possible to avoid interference from other persons, and a sibling, for example, enters the situation, the interaction was excluded from analysis.

Every attempt was made to keep the videotaping as unobtrusive as possible with equipment being set up at the farthest distance, preferably in an adjoining room. It was apparent, nevertheless, that some of the mothers were quite aware of the presence of observers, as indicated by occasional comments and glances directed toward the researcher.

Assessment of Vocal Interaction. Mutual responsiveness was assessed at six and at nine months for the frequency of occurrence of the following variables: (1) Infant vocalizes, then mother vocalizes, (2) Mother vocalizes, then infant vocalizes, (3) Infant vocalizes alone, (4) Mother vocalizes alone, and (5) Neither infant nor mother vocalizes. Contingency vocalization response variables, i.e., variables (1) and (2) were defined as vocalizations following a partner's vocalizations within five seconds. Otherwise, all variables were coded only at five-second intervals during the five-minute period.

Similarly, quality of affect was assessed at six and at nine months for the frequency of occurrence of maternal and infant variables selected by Adamson, Tronick, Als, and Brazelton (1975) as indicative of affective and attentional involvement during interaction. Adamson, et al., used 11 scales in all: 5 for the modalities of infant interactive behavior and 6 for the modalities of maternal interactive behavior. Each scale has nine points with

¹The videotaped episodes of mother-infant interaction analyzed in the present study represent a portion of the data being collected as part of a longitudinal investigation of attachment conducted by Dr. L. Alan Sroufe at the Institute of Child Development at the University of Minnesota.

a rating of one representing maximum negative involvement, a five representing neutral involvement, and nine used to designate maximum positive involvement. Only two scales, those related to the vocalization modality, were employed with minor adaptations for purposes of this study. Infant Vocalization Scale: (1) Crying, (2) Protesting, (3) Whimpering, (4) No sound, (5) Grunting or neutral sound, (6) Isolated sounds, (7) Coo, (8) Repeated coos and sounds, and (9) Gurgles and laughs.

Maternal Vocalization Scale: (1) Abrupt angry shout, (2) Stern adult narrative with tension evident, (3) Rapid tense vocalization which sounds upset or exhorting -- higher pitch than stern, adult talk, (4) Long cessation of talk; whispering, (5) Little or no vocalization for brief period; narrative with some "baby talk" adjustments, but no rhythmic pause pattern or emphasis, (6) Sounds that are rhythmic but have little internal modulations, e.g., "hi-hi-hi," (7) Burst-pause talking, (8) Single bursts in rapid succession which have a wide pitch range, and (9) Burst of sound that seems to "peak" with large change of modulation and pitch.

Two undergraduate students were trained in coding both the responsiveness and affect variables. The coders were given a cassette audio tape which served to signal each five-second interval for a period of five minutes. They were instructed to code only those vocalizations made simultaneously with the signal tone except for "responses" in the case of the mutual responsiveness instrument. Thus, for each five-minute sample, 60 codes were recorded. Since a total of 23 vocalization variables were possible, the coders assessed responsiveness (five variables), infant affect (nine variables), and maternal affect (nine variables) on three separate viewings of a given five-minute video sample. Although the coders assessed approximately an

equal number of six- and nine-month mother-infant pairs, they coded a different set of pairs at each of the two age periods. The coders were kept naive as to the maternal sensitivity ratings. The percentage of inter-coder agreement for the mutual responsiveness variables ranged from .80 to .90, with a mean of .86, while the percentage of agreement for the infant and maternal affect variables ranged from .83 to .92 and from .83 to .90 respectively, with means of .87 and .86.

Assessment of Maternal Sensitivity. Sensitivity ratings were made at six months and at nine months, based on the same videotaped interaction episodes. Three raters were trained in the use of Ainsworth's (1969) Sensitivity vs. Insensitivity¹ scale: a graduate student in psychology at the University of Minnesota, who rated mother-infant pairs at six months, an undergraduate psychology student at the University of Texas who rated the nine-month pairs, and the author, who rated pairs at both six and nine months. Thus, each subject was rated by two persons. Ratings were made independently and without knowledge of the vocalization assessments. Since one of the raters was inaccessible for inter-rater resolution of differences, differing scores were averaged in the assignment of a single sensitivity score. A score of 1 represents the lowest possible rating while a score of 9 is the highest obtainable rating. An inter-rater reliability analysis was performed, considering variation within scores as well as variation between judges. Reliability coefficients at six months and nine months respectively were .83 and .91.

Results

Pearson product moment correlation coefficients were computed to determine potential relationships between the vocalization variables and maternal

sensitivity. In order to determine the stability of relationships within the total group sample the same analysis was performed on two subgroupings, each composed of fifteen subjects. One of these groups consisted of longitudinal data exclusively while the other group contained a mixture of longitudinal and cross-sectional data. Only the most stable and significant relationships will be discussed.

Responsiveness. In general, maternal sensitivity was found to be related at six months to a lack of responsiveness between mother and baby and in particular to the complete absence of either maternal or infant sounds. (Table 1) At nine months, no significant relationships were found; however, significant developmental differences were evidenced. (Table 2) At nine months, more frequent vocalization is reflected in the negative relationship between sensitivity and the last variable, "neither vocalized." The increase in "infant vocalizing alone" at nine months suggests that the total increase in vocalization may be due in large part to greater infant vocal production. In addition to a sheer increase in vocalization at nine months, both mother and baby were significantly more responsive to each other's vocalizations.

Infant affect. The infant vocal affect variable most highly related to maternal sensitivity at six months was "no sound." The most frequently occurring infant sounds were neutral, like whimpering and grunting, and these were actually inversely related to sensitivity at six months. Each of the significant six-month affect sensitivity correlations changed direction significantly at nine months. (Table 2) Although the total-group analysis showed significant development changes in a few of the infant affect variables toward the extreme end of the scale, these changes were not stable in analysis of the fifteen longitudinal subjects.

Maternal affect. The affect variables on extreme ends of both the maternal and infant vocal scales were found far less frequently if at all in comparison with more neutral sounds. The sounds which mother and infant produce during feeding appeared to be directly related to the task at hand, feeding. Brief interludes of play were observed, but mere frequency tabulations of positive or arousing sounds were inadequate in discriminating among interactions as a function of sensitivity.

Analyses of the relationship between maternal sensitivity and maternal vocal affect demonstrate this inadequacy even more clearly (Table 1). Only the absence of maternal vocalization was significantly related to sensitivity at either six months or nine months, and at nine months, sensitive mothers were found to vocalize to their babies less frequently. This developmental difference was significant (Table 2).

Maternal sensitivity as a predictor of infant vocal production. The vocal interaction of sensitive mothers and their babies may be characterized as follows: first, mutual vocal responsiveness of the mother and baby increased from six to nine months along with an increase in the overall amount of vocalization during feeding. Secondly, the increase in vocalization among infants of sensitive mothers appeared to be the infant's contribution. In order to further explore this hypothesis, an analysis of covariance was performed -- the question was, given a sensitivity grouping, high, medium, or low, what changes occur in the frequency of infant vocalization from six to nine months? Mothers in the high group consisted of mothers rated 8 or 9 on the sensitivity scale; mothers in the medium group obtained a rating of 6 or 7; mothers in the low group were those who were rated 5 or below.² Infants

²All analyses performed with exact sensitivity ratings were also performed using the high/medium/low groupings. It was demonstrated that while grouping sensitivity ratings in this study maximized reliability, it did not significantly change the finding obtained in the analysis of exact scores.

of highly sensitive mothers and of medium sensitive mothers were found to vocalize far more at nine months than they did at six months, and significantly more than did infants of low sensitive mothers (Figures 1 and 2). Infants of low sensitive mothers, despite a greater amount of vocalization at six months than infants in the high and medium sensitivity groups, were vocalizing very rarely at nine months.

Discussion

The findings of this study of twenty-eight white middle-class mothers and infants suggests a definite relationship between maternal sensitivity and the development of mother-infant vocal interaction over the infant's third quarter of the first year of life. The strongest relationships found were those which reflected differences in the sheer quantity of vocal production, and in the contingency or temporal responsiveness of vocalizations. Since Ainsworth's sensitivity scale emphasizes the frequency and prompt response of maternal behaviors over qualitative characteristics of the behaviors themselves, e.g., pitch, rhythm, volume, it was expected that the mutual responsiveness variables demonstrate some relationship to sensitivity.

At six months, the responsiveness variables, infant vocalizing then mother, and mother vocalizing then infant, were negatively related to sensitivity while this trend reversed itself at nine months, when these two variables were found to be positively related to sensitivity. The relationship and its reversal was particularly strong between infant vocalizing then mother vocalizing and sensitivity. Thus it is proposed that maternal response to infant sounds is more indicative of overall sensitivity than is infant response to maternal sounds at nine months, when sound is a more integral part of mother-infant communication than it is at six months.

This proposition is supported by the finding that as infant-mother vocalizations became more positively related to sensitivity from six to nine months, infant vocalizing alone changed from a significant negative relationship to a slightly positive relationship. In other words, infants of more sensitive mothers vocalized alone less frequently at six months than they did at nine months, and the vocalizations they did make were less frequently responded to by their mothers. At nine months, more sensitive mothers did respond to infant sounds. The finding that mother vocalizing alone was only slightly positively related to sensitivity at either time period is consistent with the postulation that the six- to nine-month change in all other responsiveness variables was due to the increasing use of vocalization by the infant. If this were an accurate assessment, the sheer amount of mother-infant vocalizing would be expected to increase from six to nine months in the case of more sensitive mothers. Indeed, this was the finding: neither mother nor infant vocalizing was significantly and positively related to sensitivity at six months while the absence of sound was negatively related to sensitivity at nine months. Thus it may be proposed that while sensitive mothers may be responsive to their infant's signals through a variety of interactive modalities, when the infant at nine months signals with a vocalization, the sensitive mother tends to respond with a vocalization. Maternal vocal responses, of course, may be and usually are redundant to responses via other modalities.

The frequency distribution of infant affect variables demonstrates that the affective quality of infant vocalizations during feeding was most often of a neutral quality at both six and nine months. At six months, these infant vocalizations were negatively related to sensitivity. At nine months,

Infant vocal production moved significantly toward a positive relationship to sensitivity. It may be that infants of sensitive mothers vocalize less frequently at six months to signal needs and desires relevant to feeding, but at nine months rely more on vocalizations for signalling purposes.

The most stable and only significant maternal affect variable at either six or nine months was the absence of sound. At six months, no sound was negatively related to sensitivity and at nine months was positive. While sensitive mothers were found to respond more frequently to their infant's vocalizations with a vocalization at nine months than at six months, overall, sensitive mothers did less talking as their infants began to vocalize more. This finding is consistent with the findings of Barrett-Goldfarb & Whitehurst (1975) and of Webster (1973) that adult vocalizations, especially parental voices, suppressed infant vocalizations. It is proposed that sensitive mothers allow for reciprocity by adjusting their own stimulation to the vocal production of their babies. The development of vocal reciprocity may undergo greater change toward the end of the infant's first year when his ability to endow sound with meaning is growing more adequate (Eimas, 1974; Friedlander, 1968). It seems probable that highly sensitive mothers intuitively attempt to match their infant's stage of development by responding to his growing interest in sound and increasing ability to communicate through sound.

T A B L E 1

Sensitivity and Responsiveness

Infant Age	Infant-Mother	Mother-Infant	Infant Alone	Mother Alone	Neither Vocalized
6 Months	-.405	-.350	-.467*	.109	-.454*
9 Months	.339	.195	.176	.020	-.329

Sensitivity and Infant Affect

Infant Age	Crying (1)	Protecting (2)	Whispering (3)	No Sound (4)	Grunting (5)	Isolated Sound (6)	Cooing (7)	Repeated Coo (8)	Laughing (9)
6 Months	0	-.372	-.427*	-.622**	-.544**	-.363	-.072	-.326	-.332
9 Months	0	.312	.348	-.242	.324	.152	-.065	-.156	-.215

Sensitivity and Maternal Affect

Infant Age	Abrupt Shout (1)	Stern Narrative (2)	Tense Vocalization (3)	Whispering (4)	No Sound (5)	Rhythmic Sounds (6)	Burst-Fuse Talking (7)	Bursts in Succession (8)	Burst-Peak (9)
6 Months	0	0	0	.305	-.517*	-.031	0	.317	.402
9 Months	0	0	0	-.318	.495*	.185	.208	.199	.199

N = 21 *p < .05 **p < .01

N = 22 *p < .05 **p < .01

TABLE 2

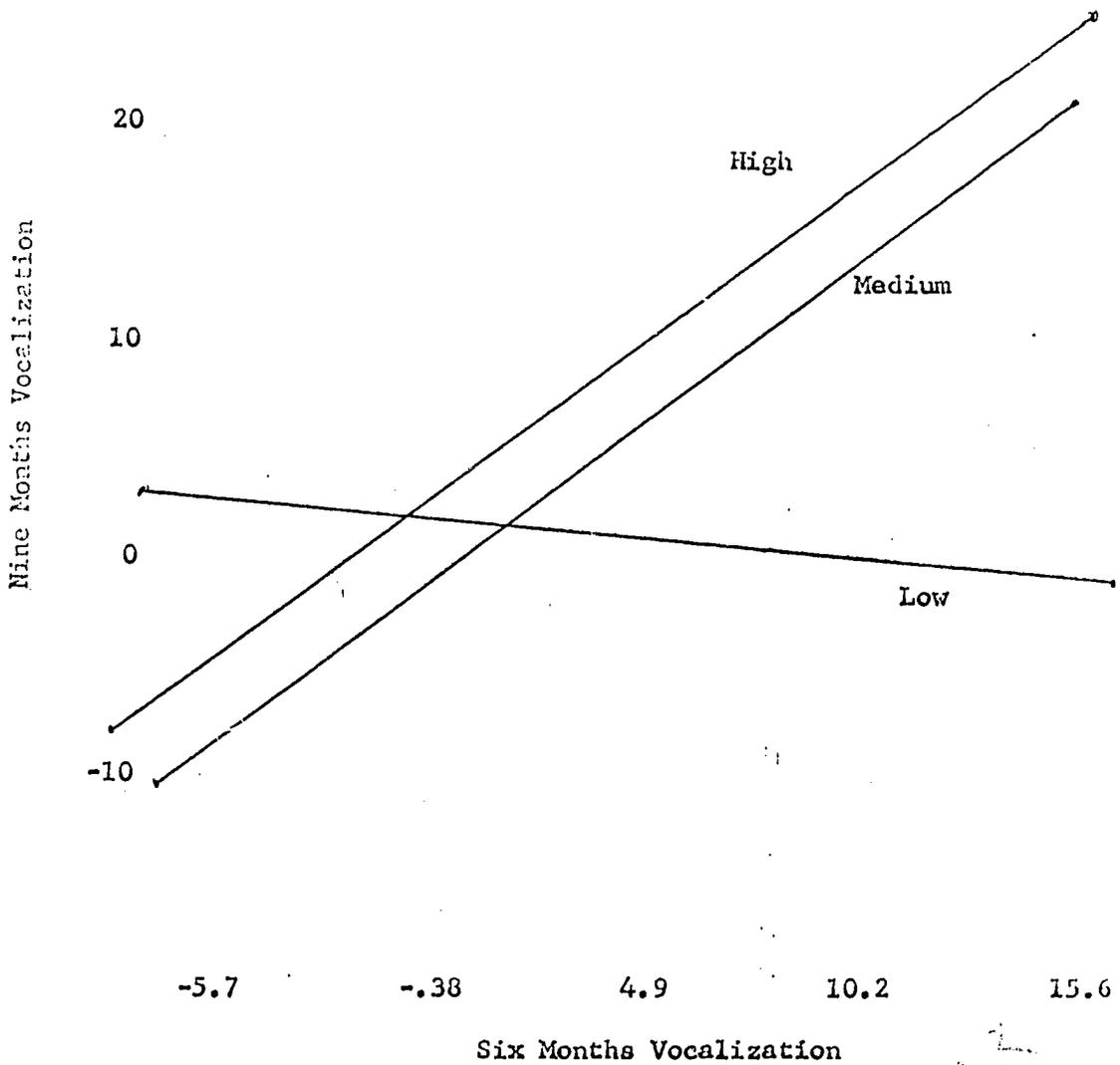
Sensitivity Relationships From Six to Nine Months

Infant Age	Responsiveness																
	Infant-Mother	Mother-Infant	Infant* Alone	Mother* Alone	Neither* Vocalized	(1)	(2)	(3)	(4)*	(5)*	(6)	(7)	(8)*	(9)*			
6 Months	-.405	-.380	-.467	.103	.454	(1)	(2)*	(3)*	(4)*	(5)*	(6)	(7)	(8)*	(9)*			
9 Months	.359	.195	.176	.030	-.329	Infant Affect											
6 Months	-.372	-.427	.622	-.544	-.168	-.322	-.326	-.332	Maternal Affect								
9 Months	.312	.348	-.242	.324	.162	-.085	-.156	-.315	(1)	(2)	(3)	(4)*	(5)*	(6)	(7)	(8)*	(9)*
6 Months	0	0	.305	-.517	-.031	0	.317	.402									
9 Months	0	0	-.318	.495	.193	.208	.199	.199									

*p < .05 or > .113

FIGURE 1

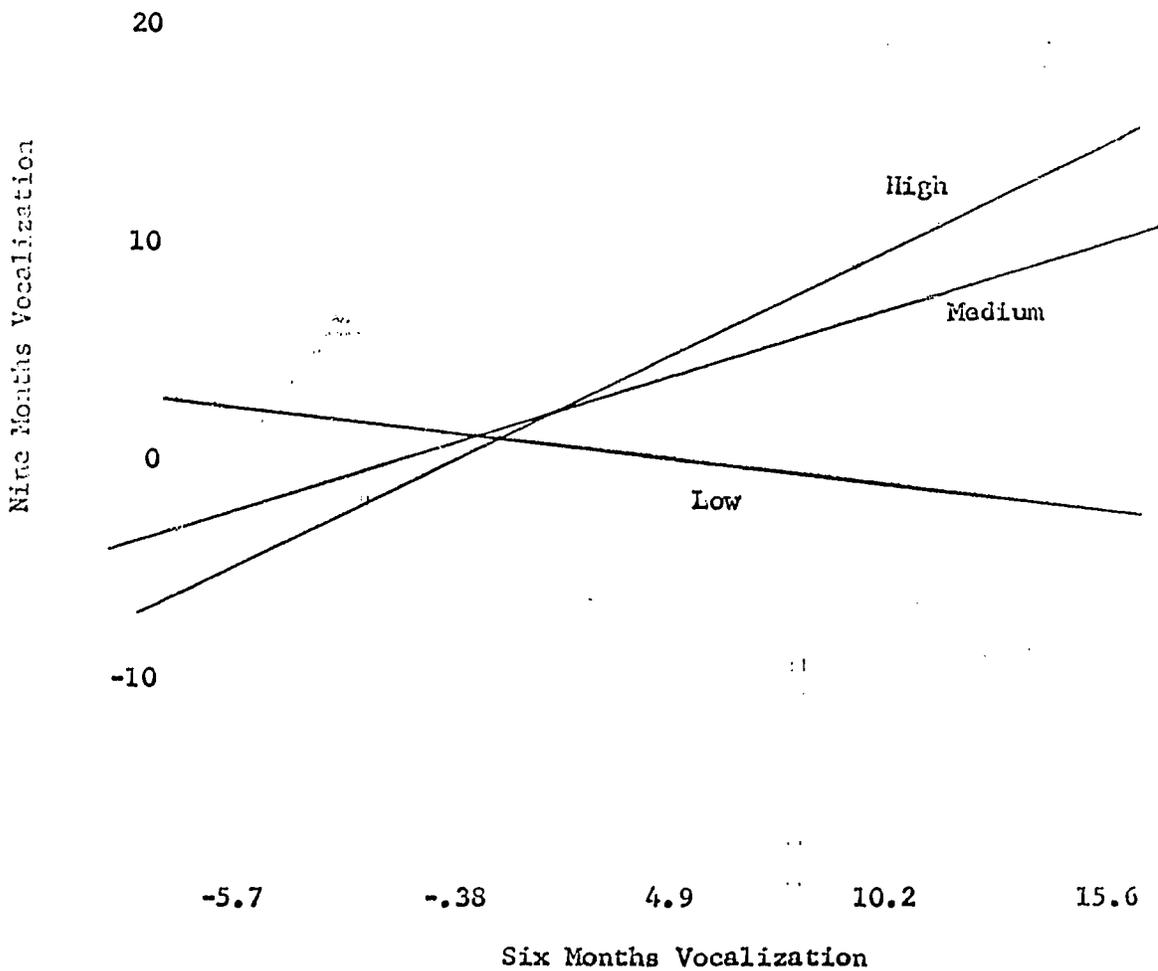
Covariance of Infant Vocalizing Alone
at Six and Nine Months with High,
Medium, and Low Sensitive Mothers
Rated at Nine Months



$p < .01$

FIGURE 2

Covariance of Infant Neutral Sounds at Six and Nine Months with High, Medium, and Low Sensitive Mothers Rated at Nine Months



$p < .01$