8027516

FRANCIS, PATRICIA LYNN

MUTUAL GAZE AND VISUAL CO-ORIENTATION BETWEEN MOTHERS AND INFANTS: IMPLICATIONS FOR COMMUNICATION DEVELOPMENT

The University of Oklahoma PH.D. 1980

University Microfilms International 300 N. Zeeb Road, Ann Arbor, MI 48106 18 Bedford Row, London WC1R 4EJ, England

THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

MUTUAL GAZE AND VISUAL CO-ORIENTATION BETWEEN MOTHERS AND INFANTS: IMPLICATIONS FOR COMMUNICATION DEVELOPMENT

A DISSERTATION

SUBMITTED TO THE GRADUATE COLLEGE

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

PATRICIA LYNN FRANCIS

Norman, Oklahoma

1980

MUTUAL GAZE AND VISUAL CO-ORIENTATION BETWEEN

MOTHERS AND INFANTS: IMPLICATIONS

FOR COMMUNICATION DEVELOPMENT

APPROVED BY

DISSERTATION COMMITTEE

Acknowledgements

I would like to express my appreciation to the many people who helped to make this research a reality. To Patti Self, I am especially and deeply grateful-her committment to (as well as expertise in) infancy research have had an impact on my professional growth which is still not yet fully realized. In addition, her support and friendship during the past three years have meant more to me than I could ever say.

To Nancy Mergler, for her general supportiveness throughout the last year, as well as her unique developmental insights, I feel greatly indebted. To the other members of my committee-Michael Akiyama, Roger Fouts, Alan Nicewander and Diane Willis, I am extremely grateful-the willingness of each of them to take time to provide guidance was most helpful in the completion of this project. Special thanks also to Larry Toothaker as well, who provided statistical advice for nothing (except this acknowledgement).

Numerous others need to be thanked for their help. First, I must express my gratitude to the mothers and infants who allowed me into their homes for apparently inexplicable reasons. Second, thanks to Dr. Kenneth Hoving, Dean of the Graduate College, for the provision of videotapes, and to Dick Rubrecht for his assistance with audio-visual equipment. Third, to those fellow students who helped me collect and code my data-Robert Bilbrey, Belinda Biscoe, Andrea Guillory, Judy

Homer, Cindy Powell and Shahrokh Shafaie-I am very grateful. To Cindy Noble go many thanks for her much-needed friendship there at the end (not to mention her last-minute fast typing!). Also, I must thank Debra DeMeis, whose empathetic support during the completion of this project was very important.

Finally, I would like to acknowledge my family, particularly my parents, for their love and sacrifice throughout the past eight years. Although they may still not understand what all of this means (No, Dad, I can't write prescriptions now!), they have never failed to provide the encouragement and support (too often financial) that I have often needed. I would like to dedicate this work to them, with the hope that they may realize just how instrumental they were in its realization.

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

MUTUAL GAZE AND VISUAL CO-ORIENTATION BETWEEN MOTHERS AND INFANTS: IMPLICATIONS FOR COMMUNICATION DEVELOPMENT

Introduction

Until recently, theory and research in the area of language acquisition focused almost exclusively upon children who were eighteen months or older. Within the past few years, however, there has been a substantial increase of interest in communication development which occurs much earlier. This increase may be partially attributed to a growing recognition of the rich language structures which already exist at the beginning of one- and two-word speech (e.g., Bates, Benigni, Bretherton, Camaoni & Volterra, 1977). Such recognition has resulted in a shift in attention from children who have started to acquire formal language to "pre-linguistic" children. In addition, because of the context in which earliest communications typically occur, mother-infant interaction has been increasingly utilized as an appropriate setting in which to examine early communication development. Research conducted in this setting has already provided much valuable information (e.g., Bruner, 1977; Lewis & Freedle, 1972).

Similarly, early visual behavior between mothers and infants has received recent attention. Much of the available data concern the occurrence of mutual gaze, particularly as it influences the attachment process (e.g., Ainsworth, 1973). More recently, the issue of joint attention to environmental features, or visual co-orientation, has been included in analyses of visual behaviors within the mother-infant dyad (e.g., Collis & Schaffer, 1975). However, the majority of this research on both mutual gaze and visual co-orientation has addressed the effects of these visual behaviors upon various social parameters, with virtually nothing being known regarding the influence of these behaviors upon other processes such as communication development.

The present research was intended to combine the two major areas of communication development prior to language and early visual interaction. Two primary goals were cited at the onset of this effort, the first of which was the documentation of mutual gaze and visual co-orientation between mothers and their 2-4 month-old infants. Also, the communicatory acts which followed the onset of these visual interactions were of interest. In addition, the present research examined the effects of infant sex, infant cognitive level and maternal sensitivity upon these visual behaviors and their accompanying communicative behaviors.

In the following literature review, both early communication development and early visual behaviors are examined with regard to their theoretical perspectives, ability in early infancy, and their occurrence within the context of mother-infant interaction. Following these presentations, a discussion of research attempts to merge the areas of early communication development and visual behaviors will be presented.

Early Communication Development

Despite the great amount of information which is available regarding language acquisition, we know very little about communication development. This seeming paradox is explained by the fact that, traditionally, language theorists and researchers have been preoccupied with the struture of language, specifically its syntactic (e.g., Brown & Bellugi, 1964) and semantic (e.g., Macnamara, 1971; Winograd, 1972) features. Such an approach necessarily focuses exclusively upon the production of language; subsequently, the eighteen to twenty-four months which precede the onset of productive language have been largely ignored.

However, it is becoming increasingly recognized that considerable communication takes place before the acquisition of formal language. In part, this recognition has resulted from a declining tendency to view language as a generative phenomenon which appears somewhat "magically" (e.g., McNeill, 1970). Subsequently, attention has been re-directed towards the pre-linguistic child. The necessity for this re-direction of attention has been emphasized by Bruner (1976): ". . . whatever view one takes on language acquisition proper--however nativist or empiricist one's bias-one must still come to terms with the role or significance of the child's pre-speech communication system" (p. 255).

In the present section, theoretical perspective on early communication development will be presented, followed by a discussion regarding the ability (both receptive and productive) of young infants to communicate. The section will conclude with a presentation of the available information regarding early communication during the context of mother-infant interaction.

Theoretical Perspectives

Mechanistic Perspective

The mechanistic orientation has provided the least information with regard to early communication development; in fact, no specific attempts to explain this process may be found. Dollard and Miller (1950), representing the social learning position, primarily make reference to language as it mediates rewards and punishments; according to these theorists, verbal cues become attached to motivational and instrumental responses. However, the development of language itself appears to be relatively unimportant. On one of the few occasions in which they mention the pre-linguistic child, they seem to consider a child without formal language as a child without any means of verbal communication: "For example, one cannot use words to motivate, reassure, reward, or guide very small children. Similarly, they cannot use words in this way for themselves" (p. 107).

The stimulus-response approach to language has recently been undertaken by Jenkins (1969). However, his account is incomplete and simplistic, with his primary assertion being that language consists in objects or other stimuli eliciting words; understanding, in the same way, consists in the association of words with objects or appropriate responses. The mechanism through which these processes occur are never made explicit by Jenkins.

Generally, approaches within the mechanistic rubric tend to contain the following assumptions when addressing language development: 1) randomness of vocalizations prior to word usage; 2) association with word usage and reinforcement; 3) the importance of imitation; and, 4) the instructional role played by adults. Each of these assumptions has received a fair amount of criticism. For example, many investigators doubt that "random" vocalizations prior to language are random at all. To illustrate, Weir (1966) cites a study in which linguists are able to reliably discriminate between the babbling of 4-6 month-old Chinese and American infants. Such findings would imply that, even in the babbling stage, infants attend to and produce unique features of the surrounding linguistic environment.

Further, the notions of reinforcement and parent as instructor have been attacked by Dale (1972); first, he points to the rapid acquisition of language acquisition, in addition to the observation that adults are rarely seen reinforcing specific, correct grammatical forms, in countering the role of reinforcement. In addition, he maintains that it is simply unrealistic to think that parents systematically train language in the way that the mechanistic interpretation suggests. This latter claim by Dale, however, may be open to question, as Moerk (1976) has recently provided findings indicating that mothers do indeed actively teach all aspects of language, including morphology and syntax. Finally, the importance of imitation in language acquisition has not been widely acknowledged by investigators outside the social learning or stimulus-response frameworks; McNeill (1970), for example, disregards this importance, making the observation that young children often emit verbalizations which are extremely discrepant from any modeled utterances they have heard.

While each of these criticisms of the mechanistic position regarding langauge development has some basis in fact, perhaps the most meaningful criticism has been leveled by Ryan (1974) concerning the failure of this orientation to consider language acquisition within a developmental framework. Certainly, this position has produced sufficiently little data regarding early communication development so as to render it relatively useless in the present paper.

Cognitive Perspectives

With respect to offering a developmental perspective of this issue, Piaget's (1951, 1952) cognitive approach has proven more useful. Not unexpectedly, Piaget views language development in general as occurring within the framework of cognitive development; specifically, this development is viewed as occurring in the transition from sensorimotor to representational modes of thought.

From Piaget's perspective, the evolution of language is described as a gradual progression of relationships between what Piaget refers to as the "signifier" and the "signified." At this point, it may be useful to explain Piaget's concept of meaning, which he describes as the simple assimilation of a sensorial image or object (i.e., the image or object has been inserted into some pre-existing schemata). The relationship between two different aspects, the signifier and the signified, constitutes meaning; the signified refers to any object, person or event being represented, while the signifier is the object, person, or event representing it. This conceptualization of meaning is easily illustrated when considering language-the signifier is clearly the word, while the signified is the represented concept.

However, as noted by Piaget, meaning becomes more obtuse when more elementary meanings (or "significations") are addressed--that is, meanings before language. In order to clarify this issue, the development of signifier-signified relationships will now be described. Piaget has proposed six such relationships which correspond approximately to his six stages of sensorimotor intelligence.

During the first three sensorimotor stages, signifiers are referred to by Piaget as "indications"--these are concrete signifiers which are connected with direct perception and not representation. The simplist indication may be observed in the first sensorimotor stage (approximately birth to one month), and is intimately related to Piaget's concept of recognitory assimilation. As an example, the child becomes able to discern the mother's nipple and seek it when hungry. Clearly, he/she is no longer relegated to suching for its own sake (reproductive assimilation) or sucking any object which is placed near his/her mouth (generalizing assimilation). Instead, Piaget states that rudimentary meaning has come into existence: the signifier in this case is the elementary sensory impression of the mouth on the nipple, while the signified is the simple sucking scheme.

A second type of indication is peculiar to the first habits and to assimilation through acquired schemata; as such, this type is observed in the second sensorimotor stage (from one to four months). For example, the infant's sucking scheme may be set into motion by placing him/her into a nursing position; such an indication is clearly more complex than the type of the previous stage. The most significant difference between these two indications is that the indication of the second stage is founded upon the coordination of heterogeneous schemata (e.g., body position and sucking response). In this example, the infant's body position serves as the signifier, with the sucking scheme again the signified.

The third type of indication is observed during the period of secondary circular reactions, or the third sensorimotor stage (four to ten months). While the first two types of indications are essentially functional and related to the infant's own activity, this third type entails an element of foresight related to objects. A good example of this indication occurs when the infant pulls a string in order to shake the attached objects. For the first time, Piaget maintains that the infant has demonstrated the use of "signals"--which, according to his definition, are signifiers which are part of the object or action it represents. In this case, the string (e.g., signifier) serves as a signal for a series of possible movements (signified). This type of meaning is still limited, however--the foresight in this case is still not "pure" in that it is still part of a motor scheme. Piaget interprets the signal in this stage as simply "releasing" some motor activity.

During the fourth sensorimotor stage (ten to twelve months), the infant develops from using signals to "indices;" these indices differ from signals in that they are not necessarily part of action which is in progress. Therefore, for the first time, an attitude of expectation may be observed in the infant; such an attitude is demonstrated in the following examples provided by Piaget (1952):

> Observation 132.--At 0;8 (6) Laurent recognizes by a certain noise caused by air that he is nearing the end of his feeding and, instead of insisting on drinking to the last drop, he rejects the bottle. Such a behavior pattern still pertains to the recognition of "signals" since the perception of sound is inserted in the schemata of sucking, but the fact that, despite his hunger, Laurent at once resigns himself and rejects his bottle seems to us to show that he foresees the events as a function of the object itself as much as of the action. He knows that the bottle is emptying although a few grams of milk still remain. (pp. 248-249.)

> Observation 133.--At 0;9 (15) Jacqueline wails or cries when she sees the person seated next to her get up or move away a little (giving the impression of leaving). (p. 249.)

Piaget refers to the ability of the child to use foresight as "prevision;" the emergence of this ability enables the child to foresee events which are associated with the signified in addition to events which are connected to his/her action. Such an operation is far more difficult than the indications of the previous three stages, in that these earlier indications functioned only to set a motor scheme in action.

The fifth sensorimotor stage (twelve to eighteen months) is characterized by increasing mobility of the infant's schemata, which allows the signifier to become even more detached from the ongoing activity. Typical observations during this period reveal that the child indicates anticipation which is based upon generalizations of experiences occurring much earlier. Examples include a child looking at her hand after rubbing in on green wallpaper, as if expecting the green to be on her hand. In this case, an earlier experience (e.g., rubbing her hand across a wall that had just been painted) literally serves as a signifier for an expected result (the signified). Clearly, these abilities serve as precursors for the emergence of representational thought.

It is during the sixth, and final sensorimotor stage (eighteen to twenty-four months) that the child acquires the use of the symbol, described by Piaget as an image which is evoked mentally or a material object chosen to designate a class or actions or objects. The visual image or the objects serves as the signifier, while the particular actions or objects are the signified.

A final achievement in acquiring language occurs when these symbols are replaced by "signs." While similar to symbols in that they also signify abstract meanings, signs are collective symbols provided by the environment; in contrast, symbols are idiosyncratic. As explained by Piaget (1952): "Symbol and sign are only the two poles, individual and social, of the same elaboration of meanings" (P. 191). Further, Piaget states that the child's first words are not "true signs"--rather, they are intermediate between the idiosyncratic symbols and the society's signs. Such an interpretation explains, from Piaget's perspective, why children's first words are usually inconsistent or unstable from context to context.

For Piaget, then, the acquisition of meaning and, subsequently language, occurs through the gradual detachment of the signifier and the signified. At first, these two are essentially identical (e.g., mouth on nipple and sucking); however, true language must be totally representative and abstract, which necessitates the complete separation of the signifier from the signified.

Despite this fairly comprehensive attention to the way in which language begins, Piaget has primarily concentrated upon language in the older child (e.g., Piaget, 1955), particularly with regard to egocentric speech. This failure to examine communication development during the sensorimotor period may be due to Ryan's observation (1973), that Piaget's theory is least testable at the most crucial points (e.g., separation of the signifier and the signified). It is more likely that Piaget simply does not consider this issue as important; rather, from his perspective these steps in communication development are made possible by the underlying cognitive structures. Therefore, further explanation is not necessary.

Several articles have been written in support of Piaget's position (Macnamara, 1972; Moerk, 1975; Sinclair, 1971); these articles have tended to especially advocate Piaget's notions of language being based upon thought. Noting that such a position requires that "the development of these basic cognitive structures . . . precede the development of the corresponding linguistic structure" (p. 11), Macnamara (1971) describes how these cognitive structures may account for the acquisition of syntax, semantics, and phonology. In a somewhat different approach, Sinclair (1971) has emphasized the importance of attaining object permanence in syntax acquisition. Unfortunately, no research has been explicitly stimulated by Piaget's concepts of early communication development; like Piaget, his supporters have remained for the most part interested in larger language.

Social Perspective

A marked contrast to the Piagetian position, especially concerning his views on thought and language, is found in the social approach to language. This approach has primarily been advocated by Soviet theorists and researchers such as Vygotsky (1962) and Luria (1969). In an overview of this perspective, Luria states that higher forms of reflection are regarded as resulting from the work of the brain as manifested in social conditions. Further, the "mind" is seen as a product of an individual's social life and an activity which was earlier shared by two people. Only later, as a result of mental development, do these earlier activities become manifested in one person. An essential role has been accorded to speech in this development, as it provides a basic means of communication for a second signal system. According to this position, then, both language and cognition develop as a result of social interaction, initially with adults.

Vygotsky (1962), in his approach to studying thought and language, stated the primary function of speech to be communication and social intercourse. From his perspective, preintellectual speech is observed which may have nothing to do with thinking (e.g., initial babbling and crying)--rather, these vocalizations are emotive in nature. Interactions with adults provide the child with models for speech and other communicative behaviors. Around the age of two, the previously unrelated developmental courses of language and thought converge, with the common denominator between these two processes being "verbal thought." According to Vygotsky, the child initially gives himself directions, modeled upon previous interactions with adults. Gradually, these vocal directions become increasingly turned inward; this progression is described by Vygotsky as going from vocal to inner speech with this inner speech literally synonymous with "thought." While it is not exactly accurate to describe thought as resulting from language from this perspective, language is viewed as preceding thought; therefore, counter to Piaget's proposals, thought cannot possibly be inherrent in individuals.

Vygotsky (1962) provides most of his empirical evidence regarding language development in older children, particularly the ways in which concepts are formed. Luria (1969), however, has addressed the issue of prelinguistic development. Similarly to Vygotsky, Luria describes the infant as interacting closely with adults from the beginning of life. During the first six months of life, the child will begin to react to certain words just as he/she has previously reacted to behaviors. For example, he/she will initiate to his/her name; however, Luria maintains that it is a mistake to consider this reaction the "signal of signals" that it later becomes. Rather, at this point the lexical side is not the dominant part of the stimulus--it must be accompanied by gestures and intonation, and addressed by a specific person in a specific situation. To this extent, these reactions can in no way be considered symbolic. It is during the second six months of the first year that the child begins to separate out the word from the entire complex of actions. Once this detachment has taken place, a gradual process occurs in which the "signal of signals" is observed (i.e., the word preserves its independence regardless of the context). Steps in this process include the establishment of an association between words and generalized relations represented in the words. In the second year, the greatest achievement is observed according to Luria--the information of relatively clear and objective meanings for words. However, meanings are initially very unstable and unclear, although it is true that gestures and intonation no longer needs to accompany the words. For example, Luria found that a child's earliest words designate not an object, but attributes of the subject; one child was observed to designate a cat by the sound "khh," but also used this same sound when referring to fur (due to its softness) and to a pin (due to its scratching quality). Such observations led Luria to conclude that the formation of words is the simplest function in language acquisition. Being able to attach meaning to a referent is not simply a matter of linking a vocalization with an object; rather, this process requires the isolation of adequate signalling attributes to which verbal symbols are then connected. From Luria's perspective, this process can only occur through practical manipulation with objects accompanied by adult instruction.

While Vygotsky (1962) and Luria (1969) offer an account of early communication development that is logical and appealing due to its emphasis upon socialization factors, the processes which result in the outcomes they describe are never specified. Also, though they emphasize language as "communication," they provide surprisingly little information regarding communication prior to language. Therefore, despite inherent differences in the mechanistic, Piagetian, and Soviet accounts of early communication development, an apparent failure to provide empirical support for their assumptions characterizes each of these perspectives.

Speech Act Theory

Ryan (1974), in criticizing the mechanistic, cognitive, and social approaches to communication development, states that they "neglect the effective environment in which the child develops. No descriptions are given of the interaction between the child and others, and there are no characterizations of the speech of others to the child; instead the child's speech has been treated as an isolated phenomenon" (p. 199). This dissatisfaction of Ryan's with traditional theories of early communication development is apparently shared by a growing number of contemporary language theorists and researchers (e.g., Austin, 1962; Bates et al., 1977; Bates, Camaoini & Volterra, 1975; Bruner, 1975, 1976; Ryan, 1973, 1974).

Instead, the approach which these individuals seem to advocate is one which has alternatively been referred to as "speech act theory," "performative analysis," or "pragmatics." Regardless of the label, the underlying assumption of this approach remains the same--it is the function, not the structure of language, which is the appropriate unit of analysis. As described by Bates et al. (1977), this approach is a reaction against the "mental objects" approach traditionally taken in investigating language development; they add that such a technique provides an alternative view of language as a social event which is carried out by humans in realistic communicative contexts.

One of the first references to a pragmatic analysis was made by Austin (1962), who emphasized the inadequacy of traditional analyses of sentences into propositions which must be true or false. Instead, he proposed that some sentences do not describe events, but are actually "events in themselves." As such, they depend upon the goals and intentions of the participants in communication, and do not necessarily relate to particular referents.

Three types of speech acts were suggested by Austin. The first class was labelled "perlocutionary;" these speech acts refer to communication which has some effect on a listener which is most often un-intended. A second type was called "illocutionary"--Austin defined this type of communication as that which, if successful, does have an intended effect. Further, both members of the communication recognize it as such. Finally, Austin proposed an "locutionary" speech act; such acts require the construction of propositions of utterances.

Language theorists and researchers interested in the beginnings of language have applied the terms used by Austin (1962) by proposing that communication develops ontogenetically from perlocutionary to illocutionary to locutionary stages. As its definition would imply, then, locutionary communication requires the onset of verbal, formal language. In contrast, an illocution may be expressed through any conventional signal, verbal or gestural, which is intentionally utilized to perform a recognized function (e.g., pointing in order to command or direct attention to an object). Finally, perlocutionary acts simply require that a signal emitted by one individual have an effect upon another person. From this perspective, the newborn's cry is clearly a perlocution. All three of these concepts have proved extremely useful in analyzing the development of communication in children; further, the progression from perlocutionary to locutionary speech acts has been confirmed by several investigators (e.g., Bates *et al.*, 1975).

Although, as indicated, pragmatics represents a relatively new approach to communication development, it has already contributed substantially to our existing knowledge of that development. Clearly, with its emphasis upon function rather than linguistic structure, it is an ideal theoretical framework from which to examine an infant's earliest communications.

Ability in Early Infancy

Ability

Much effort has been expended in examining different aspects of infant ability to communicate early in life. Research regarding this ability may generally be classified as to its emphasis upon either receptive or productive abilities. In this section, this categorization will be observed; in addition, both the vocal and non-vocal aspects of infants' productive communication will be considered.

Speech Perception and Discrimination

As alluded to previously, much of the initial impetus to examine the development of communication in early infancy was provided by research on perceptual capacities in the young infant, particularly with respect to the auditory modality. Friedlander (1970) referred to the findings of these research efforts in his "plea" for the comprehensive study of receptive language development:

> . . . judging by a number of indicators outside the main stream of the technical literature, receptive language functioning appears to involve processes and variables that lie at the very heart of mental development and the child's successful adaptation to the world of things, the people, and the world of action that surrounds him (pp. 7-8).

One of the first studies to be conducted examining early auditory perception was performed by Eisenberg, Griffin, Coursin, and Hunter (1964); these authors found that neonates responded differentially to different auditory stimulus parameters such as frequency. In addition, Hutt, Hutt, Lenard, Bernuth and Muntjewerff (1968) were among several investigators during that period to report newborn to be particularly attuned to signals which were within humans' critical speech-hearing range.

In the early part of the 1970's, many researchers attempted to determine if young infants could make fine discriminations between different auditory stimuli. In one such study, Eimas, Siqueland, Jusczyk and Vigorito (1971) used a nonnutritive sucking precedure, reinforcing high rates of sucking by presenting an artificial speech syllable ("bah"); eventually, when this syllable lost its effectiveness as a reinforcer and sucking responses decreased, a new speech syllable was introduced (e.g., "pah"). The authors hypothesized that increased sucking upon hearing the second syllable would be evidence of discrimination between the sounds. A second question they addressed was the infants' ability to discriminate between phonemic categories ("bah" and "pah") and within phonemic categories ("pah" and "pah"); Eimas et al. varied these syllables by manipulating the first formant transitions. Results indicated that infants as young as one month of age reliably discriminated between the phonemic categories; however, increased sucking was not observed when the within-category stimulus change was made. The authors concluded that the infants in their study were utilizing phonemic, and not simply acoustic information to discriminate the stimuli. Moffitt (1971) obtained similar results regarding the ability of 20-24 week-old infants to discriminate between phonemic categories, using a cardiac deceleration-cardiac recovery paradigm; however, this author did not address within-phonemic category capabilities.

In each of the studies by Eimas _et al_. (1971) and Moffitt (1971), synthetic sounds were used. Other early studies utilized natural language stimuli; these studies were conducted more for the purpose of assessing infants' desire to hear language, not perceptual abilities. As reported by Friedlander, Turnure (1969), in a laboratory study, observed the attentional responses of 3-, 6-, and 9-month-old infants to recordings of their mothers' natural voice, their mothers' voice mildly distorted, and a grossly distorted version of their mothers' voice. Turnure reported that the older infants attended more to the voices overall; also, a strong but non-significant trend for 9-monthers to attend more during the natural voice and less to the distorted voices was observed. Turnure admitted the weakness of the data, but did conclude they indicated infants' interest in voices.

Friedlander (1970) reported a similar, more methodologically-sound study which was performed in the homes of infants from 11 to 15 months of age. In this research, a toy referred to as "Playtest" was placed in the home, and the infants were allowed to manipulate it in any way and to any extent they wished. Various tapes were available on the toy, and the researchers observed the types of tapes preferred by the infants. Results indicated no uniform preference by the sample for the maternal voice tape; however, individual infants did demonstrate various preferences based upon intonation, vocabulary, and redundancy.

Perhaps because of the ambiguous results obtained by both Turnure (1969) and Friedlander (1970), research on auditory capabilities and discrimination which has been conducted during the 1970's has more closely modeled the studies reported by Eimas _et al_. (1971) and Moffitt (1971).

This recent research has confirmed the abilities of the young infant to differentiate between many types of auditory stimuli. Trehub (1973), for example, examining differentiation of vowel contrasts, reported that 4-17 week-old infants detected certain vowel changes when following common consonants or when occurring alone. Fodor, Garrett and Brill (1975) found that 14-18 week-old infants grouped together English syllables on the basis of a shared consonant. Finally, Miller, Morse and Dorman (1977) have recently demonstrated reliable burst-cue discrimination by three- and four-month-old infants.

Considered together, these data, which have primarily been collected during the past decade, indicate that infants begin at an early age to respond attentively and discriminatively to a wide variety of auditory stimuli. As Friedlander (1970) notes:

> Whatever these data ultimately may be interpreted to signify, there can be little quarrel with the evidence that listening to sounds and voices seems to have hitherto unsuspected potency as to desirable form of activity to babies whose own speech has barely advanced to the stage of one and two word sentences (p. 19).

Production-Vocalizations

In comparison with the receptive language abilities considerably less is known concerning productive capacity in the very young infant. With regard to vocalizations, the majority of research efforts have focused either upon crying or upon speech sounds. Ontogenetically, the birth cry is clearly the infants' first postnatal vocalization, and has received a good deal of attention. In one of the earliest examinations of the birth cry, Irwin and Chen (1941) reported little difference between the birth cry and other cries emitted by the neonate. A more sophisticated approach was utilized by Lynip (1951); this author, attempting to compare early infant vocalizations with adult sounds, employed spectographic analysis of a newborn female's birth cry. Results indicated that these analyses were markedly dissimilar from spectographic analysis of adult sounds.

The most comprehensive analysis of infant crying has been reported by Wolff (1969). From observations of 18 infants over the first month of life for 30 hours a week (and subsequent longitudinal observations for some of the infants across the first six months of life), Wolff proposed a "morphology" of early infant vocalizations. In so doing, he identified three different types of cries which were clearly discernible. First, the "hunger cry" was found to have a predominate frequency of 350-400 cycles per second. Also, a typical hunger cry sequence was found: an initial cry (generally lasting .6 seconds) would be followed by silence (.2 seconds), which would in turn be followed by a whistling sound of a higher frequency than the initial cry (.1- .2 seconds). Finally, after a brief rest, the initial cry would start the sequence again. Despite its name, this cry was reported by Wolff to not always be associated with the hunger state; instead, he referred to this particular cry as a "basic" cry.

A second cry identified by Wolff was somewhat more specific. This "mad cry" was characterized by an excessive amount of air being forced through the vocal cords, creating what Wolff called a "paraphonation." Other than this marked expiration, the mad cry is very similar to the hunger or basic cry. Finally, Wolff, primarily by recording infants who had just had their heels pricked in the hospital, noted a "pain cry," stating that this vocalization could be differentiated by these factors: a sudden onset without preliminary moaning, an initial long cry, followed by an extended long breath (silence); at this point, the pain cry settles into the basic cry. According to Wolff, each of these three cries was found in all observed infants.

As interesting as these cries may be in themselves, a more interesting finding concerns the effects of these various cries on caregivers. Wolff reported that each of these cries resulted in dramatically different caregiver behaviors, as early as the newborn period. With regard to the hunger cry, Wolff found that there was a good deal of individual differences between mothers in their response to this vocalization. Factors found to affect this responsiveness included parity: Multiparous mothers were more likely to be somewhat more leisurely in their responses than were primiparous mothers. In reacting to the mad cry, however, most mothers exhibited a more specific and quicker response. Finally, the pain cry resulted in the most dramatic maternal response; Wolff found (upon playing the infants' tape-recorded pain cry while the mother was out of the room) that mothers would quickly come to the infants' room, often with worried looks on their faces.

A fourth pertinent type of cry reported by Wolff appears by the third week of life. This was labelled as a "fake cry"; this cry, of very low pitch and intensity, resembles long drawn-out moaning which may result in a explicit cry, but typically reverts back to the moaning. Again, mothers became quite expert at discerning this cry, often commenting that there was "really nothing wrong with the baby."

Wolff also commented upon non-crying vocalizations appearing during the early months of infancy. During the fourth week, infants began to chuckle and laugh upon being tickled. Also during the first to second months, Wolff observed fussy babies quieting upon seeing a human face or hearing a human voice. During fussy periods at this time, the infants first began to emit novel sounds. Finally, toward the end of the second month, novel sounds continued to be made; however, these were no longer found exclusively within the context of fussiness. Instead, the infant began to invent new noises in alert, non-fussy states.

With specific reference to speech sounds in early infancy, the most valuable information has been provided by O. C. Irwin and his colleagues. Irwin and Curry (1941) examined elements in the vocalizations of 40 infants who were less than 10 days old. These authors, transcribing the speech sounds uttered by each subject according to the international Phonetic Vocabulary, reported that infants this age made very few consonant sounds; however, four distinct vowel sounds were identified.

Perhaps one of the more intriguing findings in research of this type involves the fact that early infant speech sounds gradually come to approximate adult sounds. For example, in the study by Irwin and Curry (1941), of the vowel sounds emitted by the infants less than 10 days old, 92% were front vowels, while 7% and 1% were middle and back vowels, respectively. Irwin (1948), in a 30-month longitudinal study beginning at birth, reported that the place of vowel articulation changed dramatically during the first 30 months. In illustration, at two months, front, middle, and back vowels were found to occur respectively, 72%, 25%, and 2% of the time. At 30 months these respective totals were 47%, 17%, and

37%. As noted by Irwin, these 30-month percentages are very similar to those found in English-speaking American adult samples.

An analogous procedure occurs with the placing of consonant articulation. Irwin (1947) reported that during the early months of life, rear consonants dominate (for example, at 2 months, 87% are glottals while 12% are velars). By 30 months, however, postdentals and labials (which occurred less than 1% of the time at 2 months) rise to 53% and 26%, respectively. Again, these percentages resemble those found in adult samples. Also, it appears that vowels progress from front to back articulation while consonants develop from back to front.

With regard to the young infant's repertoire of speech sounds, Chen and Irwin (1946) found that, on the average, two-month-old infants possessed 4.5 different vowel sounds and 2.7 consonant sounds. By 30 months, these respective sounds increase to 11.4 and 15.8; these numbers compare favorably with the total number of 35 phonemes estimated to be used in adult speech (Chen & Irwin, 1946).

Another aspect of vocalizations in early infancy concerns the occurrence of imitation of sounds. Although language researchers (e.g., McNeill, 1970; Whitehurst & Vasta, 1975) disagree regarding the importance of imitation to language development, the prevalence of vocal imitation in the first year of life has been documented, and it would appear that rudimentary forms of vocal imitation occur quite early. Lewis (1936) has provided a detailed description of vocal imitation within the first 12 months of life, and has identified three distinct stages. First, during the first four months, infant vocal imitation primarily consists of vocal responses to adult speech; these responses will not necessarily bear a strong resemblance to the modeled stimulus. Between the fourth and ninth month, Lewis noted a period of "abeyance," during which a decrease, and often a complete cessation of vocal imitation occurred; Lewis attributed this decrease to the child's growing awareness of word meaning. Finally, around nine months, "true" imitation was observed; this imitation, in contrast to the rudimentary forms observed in the first four months, more frequently were similar to the vocalizations heard by the infant.

More recently, Uzgiris (1972) has presented systematic data on early vocal imitation. From longitudinal observations of twelve infants throughout the first two years of life, Uzgiris reported imitation by all of the infants of cooing by the third month; vocal responses were made to a babbling stimulus by 10½ months, while actual imitation did not occur in all of the infants until the thirteenth month. By the nineteenth month, novel sounds were imitated, and imitation of familiar words occurred by the twenty-third month. Finally, new words were imitated by the sample during the twenty-fourth month. It should be noted, however, that at least ½ of the infants in the sample attained these various levels of vocal imitation considerable earlier than these reported times.

In summarizing the available information on vocalization capacity in the young infant, it would appear that by at least 2½ years of age, infants' vocalizations are quite similar to those of adults; similarly, by two years of age, they seem very adept at mastering complex vocal imitation. For the purposes of the present study, however, the vocalization capacities of the infant within the first four months of life are more pertinent; these capacities are obviously limited. Indeed, most of the vocalizations emitted by infants this age appear expressive in character. Still, these limitations do not mean that vocal communication does not take place between 2-4 month-old infants and their caregivers. It may well be, however, that during this time infants' non-vocal communications are particularly salient. Several researchers have recently recognized the importance of such communication, particularly body movements and hand gestures; the available information will now be reviewed.

Production-Non-Vocal Communication

In a performative analysis of early communication (particularly as manifested in eye contact and pointing), Bates, Camaoini and Volterra (1975) conducted a longitudinal study of three infants (initially aged 2, 6, and 12 months). Using the definitions of Austin (1962), which were earlier explained, Bates *et al.* maintain that infant communication within the first six months of life is perlocutionary--that is, the effects of infants' communicatory acts are non-intentional. These authors, who were largely guided by a Piagetian perspective, defined intention as the ability to simultaneously utilize social and object schema (i.e., use a person to acquire a desired object, use an object to get a person's attention). Referring to this first mode as a "proto-imperative" and the second as a "proto-declarative," these authors reported that neither of these were observed in infants less than ten months of age. Specifically concerning non-vocal communication, Bates *et al.* noted the frequent use of gestures and eye-contact to get adults' attention in the early months of life; however, since these were never coupled with gestures or eye contact with objects, the authors implied that any communicatory intent was simply inferred by the caregiver.

One researcher who is sure to argue with Bates et al.'s (1975) interpretation of infant intention is Trevarthen (1974, 1977). In his 1974 article, Trevarthen noted the markedly different responses made by infants to objects and to people as early as two weeks of age. In particular, differences were readily apparent in hand and facial movements. These different behaviors were classified by Trevarthen into two modes: a "communication" mode with people and a "doing" mode with objects (e.g., exploring, grasping, kicking, putting into mouth). In addition, Trevarthen cited infant acts at two months which closely resembled those of adults in conversation. One of the more intriguing observations is a phenomenon labelled as "prespeech" by Trevarthen; he describes this as moving the lips and tongue without producing sound. Also observed were handwaving movements, which were very similar to those made by adults when engaged in conversation.

In an expanded version of this earlier article, Trevarthen (1977) extensively described his techniques designed to detect communication intent in babies too young to utter words; in so doing, he emphasized the necessity for focusing upon visible communication. Describing the two-month-old, Trevarthen stated, "the infant periodically emits extremely complex expressive acts that are like acts usually thought to be learned conventional signs in human social exchange" (p. 248). Among these acts he included smiling, quizzical eyebrow movements, and sad vocalizations or crying.

Referring again to the prespeech phenomenon, Trevarthen stated that associated with smiling are more subtle mouth and tongue movements performed silently; in addition, these actions typically occur as an integrated communication act which gives them special communicative significance. Describing normal patterns of a 2-month-old talking to an attentive caregiver, Trevarthen notes the following sequence. First, an alteration of expression occurs, usually manifested by facial orientation, focalization upon the caregiver's eyes, and smiling; after this configuration, an increase in body activity is observed, followed by some vocalization and, finally, a gaze shift away from the caregiver. Characterizing this sequence in terms of orientation, recognition, expressive, and termination phases, Trevarthen states that the prespeech phenomenon is most likely to occur in the expressive phase; also, caregivers often interpret these mouth and tongue movements as attempts to talk.

Further, accompanying the prespeech movements and the vocalizations to the caregiver are movements of the whole body (i.e., changes in head position, trunk and limb movements). Most conspicuous according to Trevarthen are the hand and arm movements which are often closely synchronized with the infant's utterances or grimaces (within .1 of a second, typically). More vigorous calls or shouts are generally combined with longer movements, including handwaving with the palm directed forward from a position above shoulder level. Finally, Trevarthen maintains that prespeech in particular is often combined with finger movements, including pointing with the index finger. When the infants become animated, they typically show hand-waving, pointing, and fingertip clasping near their face; Trevarthen refers to movements such as these as "gesticulation." Perhaps a related finding by Fraiberg (1974) would be appropriate to mention at this point. This researcher, in her work with blind infants, has reported observing "hand language" by these infants; such hand language appears to be a fairly sophisticated sign system, allowing the blind infants to express themselves in different ways even when their facial expressions remain passive. Trevarthen reported that all of the infants in his sample demonstrated some form of gesticulation by the second month, with stereotypic behaviors such as handwaving and pointing occurring quite frequently.

Although the available information regarding the utilization by infants within the first few months of life of non-vocal communication is quite limited, the reports by Trevarthen (1974, 1977) indicate that by two months of age infants have a fairly extensive repertoire of behaviors which may be employed within a communicative context. The issue of intention is at this point unresolved; communicatory intent within the first few months of life would appear to depend upon one's theoretical perspective. More important, such an issue probably becomes insignificant when communication between infants and their caregivers is the question of interest. In other words, intention is not as crucial as the continuation of the communication. Such a view is clearly compatible with theorists and researchers operating within a pragmatic or speech act perspective. Until methods which allow the clear detection of intention in the first months of life are devised, the issue of communicative intention is a moot point. Instead, researchers will have to continue to focus upon the outcome of the infant's behaviors.

From the literature regarding the productive abilities of the very young infant, it seems that by combining both vocal and non-vocal abilities, these infants are quite capable of participating in communicative exchanges. Primarily due to infant age, most of the infant's utilization of these abilities have been examined within the context of mother-infant interaction. The following section briefly reviews prevalent findings.

Context of Mother-Infant Interaction

The importance of studying communication development within the context of mother-infant interaction have been strongly emphasized by Ryan (1973, 1974) and Bruner (1975, 1976, 1977). Perhaps as a result of their persuasive arguments, there has been a recent influx of research using this approach, most of which has confirmed its utility. This growing body of literature suggests that communication development is very much facilitated through mother-infant interaction in several ways.

First, as noted by Ryan (1973), mother-infant interaction automatically provides an interpretative context to the infant. Although most of a child's utterances and behaviors are not linguistic in any conventional sense, most of these take place with adults who are highly motivated to understand them. Again, the question of perlocutionary behaviors is raised. Bruner (1976) is among those theorists who urges that intent not be taken too literally; rather, emphasis should be placed upon intention-imputing situations.

Due in part to the interpretative efforts of the mother, then, it appears that communicative interactions are established relatively early in the prelinguistic period; these interactions have been noted by numerous researchers (e.g., Bateson, 1975; Brazelton, Koslowski & Main, 1974; Trevarthen, 1977) who describe them as being "conversational." More important for the subsequent communication development of the infant, the literature indicates the beginnings of valuable skills which are essential for effective language acquisition.

One basic skill acquired within the context of mother-infant interaction is that of alternation. Certainly, the knowledge of alternating utterances is crucial to participation in communication sequences. Although there is some indication that infants are born with some propensity to participate in alternating sequences (e.g., Condon & Sander, 1974), the experiences which are provided in interaction with the mother certainly further the development of this skill. In a non-communication setting, Kaye (1977) has described the turn-taking which occurs in a feeding context; he reported that a "dialogue" gradually developed between the infants' pauses in sucking and the maternal jigglings of the bottle or breast. He further speculated that advanced stages of alternation during feeding could possibly serve as a primitive phase with respect to more complex types of communication. As he notes, "turn-taking is more than just a characteristic of language, whether learned or unlearned; it is a necessity for the acquisition of language" (p. 93).

Other researchers have been interested in the ways in which specific linguistic concepts begin to appear within the context of mother-infant interaction. Bruner (1975, 1976, 1977), for example, has found that within this interaction, the infant gradually acquires referents or labels for objects; although the infant's first labels are typically non-standard, verbal interactions with the mother result in conventional label usage. In addition, Bruner (1975) has described the acquisition of syntax through interaction of infant and mother; such acquisition becomes possible primarily because of the order which is imposed by the mother upon actions upon objects and upon the infant.

Semantic development has also been addressed as it is facilitated by mother-infant interaction. Describing the mother-infant dyad as a communication network which constrains behavior and therefore gives meaning, Lewis and Freedle (1972) examined the frequency of various mother and infant vocalizations in different locations of the house. These authors reported that both mothers and infants did show differential vocalizations from context to context. According to these researchers, it is the situational context which help to form the bases for the acquisition of meaning. For example, their finding that most infant vocalizations occurred while away from the mother indicated that infants use early vocalizations as a means of retaining contact with their mothers. They further speculate that it is not unreasonable to think that context may have even more direct effects upon semantic notions; for example, infants who are allowed to roam freely might be better equipped to form the semantic concept of direction.

Finally, vocabulary development has also been assessed as it progresses within the interactional context. Connell (1978), for example, examined the relationship between modes of mother-infant interaction and the development of toddler vocabularies. Beginning the study at twelve months of age and following the infants and mothers for six months longitudinally, Connell reported that attachment of the infants to their mothers (as assessed on the Ainsworth scale) was significantly related to vocabulary size in the eighteenth month; specifically, those female infants who were sensitive to the departure and return of their mothers had a much larger vocabulary than those infants who showed little evidence of disturbance at maternal departure. Connell does not speculate as to the reason for the sex difference. He does conclude that infants who are observed to spend more time in social interaction with their mothers are likely to engage in more vocal exchanges; this higher amount of vocal interaction may account for the larger vocabularies. Unfortunately, the study of Connell tells us nothing regarding the appearance of specific lexical items; as of yet, those data are not available.

However, the research which has been done regarding the development of communication within the context of mother-infant interaction does indicate that during this time basic foundations are being established which will later make language easier to master. For example, the basic skill of turn-taking appears to be very much enhanced by these interactions; further, the implications for the development of reference, semantic and syntactic concepts, and vocabulary, although less systematically documented, seem nevertheless significant. At the very least, the interactions between infants and their mothers with respect to early communication development merit further investigation.

Summary

In concluding this section, it should perhaps be emphasized that the examination of early communication development has undergone dramatic changes, both in theoretical and in methodological respects, even within the last few years. These changes are most clearly represented by the increasing interest in the younger and younger infant; also, with respect to methodologies, a growing utilization of micro-analytic techniques is still occurring. The rapid accumulation of new data is placing conventional theoretical perspectives in jeopardy, in that none of these perspectives can "handle" the communication competencies of the very young infant.

In addition, the emphasis upon the infant shortly after birth has necessitated the examination of communication within the context of mother-infant interaction. Research conducted in such a context has already supplied new and intriguing data. The proposed research would also utilize this setting, in the hopes that questions which remain to be answered might be resolved.

Visual Behavior in Early Infancy

As with communication development in infancy, much attention has been paid to various aspects of infant visual development. Similarly to the section on infant communication, the present section is arranged in the following manner. First, theoretical position regarding early visual behaviors (particularly in interaction with others) are presented, followed by a discussion of the visual ability of young infants. Finally, the significance of visual behaviors (both mutual gaze and visual co-orientation) to mother-infant interaction is addressed.

Theoretical Perspectives

Ethological Perspective

Much of the information which has been provided on visual behavior in early infancy has been supplied by ethologically-oriented researchers and theorists. In particular, the importance of infant visual behaviors for the development of mother-infant attachment has been explored. According to one of the more prominent attachment theorists, Bowlby (1958), attachment behavior in the infant is composed of a number of component instinctual responses which are at first independent of each other. These behaviors, which include sucking, clinging, visual following, crying, and smiling, mature at different times and develop at different rates. However, each of these behaviors is similar in that they elicit maternal caretaking responses. Also, from Bowlby's conceptualization, visual following by the infant of the mother is one of the behaviors used by the infant to keep him/her in contact with the mother.

Ainsworth (1972) has more recently advocated Bowlby's position; also, he has supplied empirical evidence in support of the ethological perspective. As noted by this author, the concept of biological function is crucial to an ethologically-oriented theory of attachment; despite the fact that infants no longer face the dangers they once did in earlier times, Ainsworth maintains that the protective function of attachment is still advantageous. With specific regard to visual behavior, Ainsworth notes its importance in the attachment process, particularly within her first two phases of attachment. During the first or "initial preattachment" phase, Ainsworth states that eye following is "proximity-promoting;" in addition, this behavior is universal, appearing in all cultures. During this phase, however, such visual following is likely to be non-differential, as are all indices of attachment; therefore, it is not regarded as a true attachment behavior. Not until the second attachment phase, or "attachment-in-the-making," does differential following occur. At this point, then, Ainsworth says this visual following constitutes a true index of attachment. Also during this phase, Ainsworth notes the efficacy of a full face-to-face confrontation in causing infant smiling.

One problem with the ethological approach is the apparent neglect of eye-to-eye contact between infant and mother. Robson (1967) argues for the inclusion of this mutual visual regard as also being an elicitor of caretaking responses. According to Robson, the infant is predisposed to look into the caregiver's face; such visual behavior triggers visual responsivity from the caregiver, resulting in mutual regard. This visual responsivity by the infant is also postulated to result in social and emotional responses by the caregiver. From an ethological perspective, then, visual regard is one of the behaviors emitted by the infant which ensures a bond with the caregiver, and, consequently, his/her survival.

Social Learning Perspective

In contrast to the ethological perspective, social learning theorists are much more interested in the antecedents and consequences of both infant and maternal visual behaviors. Gewirtz (1969) has offered a conditioning analysis of mutual visual regard which is established between mother and infant. According to Gewirtz, any behavior of the caretaker comes under stimulus control of the appearance of behavioral stimuli provided by the infant. Similarly, the reverse holds true for infant behaviors. From this account, progressively longer S-R interaction chains between the infant and caregiver are established. Visual behaviors between mother and infant are simply specific examples of this general case. Far from attributing the tendency of infants to orient to the face and eyes, as well as visual regard and following to a necessity for survival, Gewirtz maintains that these tendencies are conditioned through interactions with adults. Mutual visual regard is explained, then, by the mother's behaviors upon being contacted visually being reinforcing for the infant; similarly, the mother is very much reinforced by the establishment of eye-to-eye contact with her infant.

Each of these positions has supplied empirical evidence for support. Among those researchers contributing ethological analyses of visual behavior are Brazelton et al. (1974), Fogel (1977), and Stern (1977). Social learning theory has also yielded evidence for their position; for example, Etzel and Gewirtz (1967) demonstrated that eye contact of the infant for the mother could be instrumentally conditioned. Neither position, however, has provided convincing proof that their assumptions completely account for the phenomenon of early visual behavior.

Early Visual Abilities

Despite early beliefs regarding the inability of very young infants to see, recent evidence has demonstrated that the visual ties of these infants are relatively sophisticated. McGurk (1974), in presenting a detailed anatomical and physiological description of the eye of the human infant, concludes that, although immature, the infant's visual system is functional at birth, and is completely capable of responding to stimulation.

In terms of behavioral responses to environmental stimulation, Fantz (1961, 1963, 1964) has provided some of the most prolific body of research. For example, Fantz (1961), in assessing the infant's perception of form, presented 30 infants, 1-15 weeks old, with four pairs of test patterns differing in complexity; results indicated the infants exhibited more looking at complex pairs, with the relative attractiveness highly dependent upon the patterned stimuli (at all ages). A second study reported in the same article was designed to discover age differences in visual acuity; infants were therefore presented with a series of patterns composed of black and white stripes (differing in stripe width) paired with a plain square of equal brightness. This study revealed that the width of the fines stripes which could be distinguished decreased steadily with age. By 6 months, the infants could see 1/64 inch stripes from 10 inches, and even infants less than one month could see 1/8 inch stripes from this distance.

Fantz (1963) essentially replicated this study with newborn infants (aged 10 hours-5 days). Results revealed that the 18 infants in the sample showed twice as much visual attention to patterns as to plain colors; these differences were significant for both infants older and younger than two days. In order of preference, it was shown that the infants fixated to these stimuli: face--circle--newsprint--colors. In his conclusion, Fantz claims that these results challenge the view that the visual world of the newborn infant is formless or chaotic.

Subsequent research attests to the various visual capabilities of the young infant. Of particular interest has been the finding found by Fantz (1963) regarding the preference for the human face. Haaf and Bell (1967) found that 36 4-month-old infants exhibited significantly more fixation time to facila stimuli; further, the degree of facedness was manipulated, and it was found that the infants' preferences were found to steadily decrease as facedness decreased. Although some have argued that it is the complexity of the stimulus which determines infant preference for facedness, Haas and Bell controlled for this variable and still found more preference for facial configurations. More recently, Goren, Sarty, and Wu (1976) have reported that infants as young as seven minutes old show significantly more preference for facial configurations.

Other variables which have been found to affect infant visual preference include contour and complexity. Karmel (1969) compared infant preference to these two dimensions and found that contour was a much better predictor of preference than complexity for 13- and 20-week-old infants. Specifically for contour, an inverted-U function was found: that is, moderate amounts of contour was preferred compared to excessive or minimal amounts. Further investigation of contour by Salapatek (1975) indicates that, while contour is particularly salient in the first two months, after this point the infant capable, either due to experience or maturation, of escaping the lure of contour.

Finally, some developments within the first several months have been reported, regarding changes in infant visual abilities. For example, Salapatek (1975) reports that there is a shift in the infant's visual selection from external to internal features of a face during the first two months; this shift also occurs for objects such as boxes, etc. Also, infant visual memory has recently attracted a good deal of attention. In one of the earlier attempts, Fantz (1964) presented 6 25 week-old infants with pairs of photos, one of which was constantly repeated while the other was variable. Fantz's results revealed that infants over two months of age decreased their attention or habituated to the same visual pattern being repeatedly presented, attending significantly longer to the novel than the familiar pattern. Noting that in order for early visual experiences to be meaningful, there must be some way for them to be stored, Fantz concluded that incidental visual experiences could be retained by infants over two months, at least for short periods.

Therefore, there should be no question that the infant in the early months of the first year of life, is possessed with more than adequate visual abilities. As noted in the theory section, considerably less is known about how infants use their visual abilities; much of what is known has been discovered in research conducted on mother-infant interaction. A review of this information follows:

Occurrence Within Mother-Infant Interaction

There has been a recent surge of interest in the role which visual behavior plays in the interaction between mothers and infants. Of this research, the majority has been conducted on the phenomenon of mutual gaze, or eye-to-eye contact. Much less information is available about the phenomenon of visual co-orientation, or the visual attention of mother and infant to the same environmental feature.

Mutual Gaze

Kendon (1967) was one of the first researchers to remark upon the phenomenon of mutual gaze; using adult samples, he assessed the occurrence of utterances as they related to mutual gaze and gaze shifts. More recently, mutual gaze has become a major interest of mother-infant interaction theorists and researchers. Stern (1971), who was particularly interested in identifying specific interactions between defined infant and maternal behaviors (e.g., "overstimulating," "controlling" maternal actions), noted the immense importance of the visual system in regulating social behavior, especially within the first half of the first year of life. In his study, Stern analyzed a 7-minute interaction between a primiparous mother and her 3½ month twins. According to Stern, one of the twins was "overstimulated" while the other twin was not; marked differences were noted in the face-to-face interactions between the mother and the two infants. Specifically, the overstimulated twin was more likely to gaze avert, while the other twin maintained mutual regard. Further, later observations at 12-15 months revealed that the overstimulated twin was significantly less likely to make prolonged eye contact with other individuals.

Similar results have been reported by Brazelton et al. (1974), who conducted a longitudinal study of five mother-infant pairs from 2-20 weeks of age. Describing cycles of looking and non-looking, these researchers found that for the infants, their visual cycles were characterized by a constant cycle of attention to the mother, followed by withdrawal of attention. In contrast, they found that mothers hardly ever looked away from their infants, particularly if their infants were looking at them. This asymmetric looking pattern has consistently been reported in discussions of visual regard between mother-infant pairs (e.g., Fogel, 1977; Stern, 1974).

With regard to the results reported above by Stern (1971), Brazelton et al. found that the amount of visual stimulation given by the mother was important for mutual regard. For example, two types of maternal reactions were observed in the situation of infant withdrawal. One reaction involved increasing the amount of activity and stimulation to the infant, while a second was to "correspond" to the infant's withdrawal--that is, to adjust her rhythm to her infant's, following his/her cues for attention and withdrawal. In terms of effectiveness, the first maternal reaction typically resulted in an infant who became less and less responsive; also, infant looking decreased steadily in this case. The second approach, in contrast, was responded to by increased infant visual regard. Both the results obtained by Stern (1971) and Brazelton _et al_. would indicate that maternal sensitivity is very important to the gazing patterns between mother and infant.

Perhaps the importance of mutual gaze between mother and infant can most clearly be illustrated by examining special cases in which this mutual gaze is not possible or abnormal. Fraiberg (1974), in her research with blind infants, has offered much useful information on this point. From longitudinal examinations of 10 blind infants and their mothers, Fraiberg noted that these mothers had difficulty in feeling attached to their blind infants, primarily because the infants' signs were either obliterated or distorted. As Fraiberg notes, eye contact connotes greeting and acknowledgement, and often elicits a smile from an infant. In this sample, however, these smiling behaviors did not appear as early as for seeing infants; in many cases, this lack of affect was interpreted by the mothers as meaning the infants were not interested in interaction. Along these lines, Hutt and Ounstead (1966) have commented upon the tendency of autistic children to avert their gaze from others; as a result, Hutt and Ounstead maintain that ambivalent maternal attitudes may develop.

Infants may be affected by the lack of mutual regard as well. In an experimental manipulation of eye contact between infants and an experimenter, Bloom (1974) was interested in the effects of this manipulation upon the simultaneous reinforcement for infant social behaviors. Bloom's results indicated that without eye contact, social reinforcement for infant vocalizations was ineffective; she therefore concluded that eye contact serves as a "setting event" for reinforcement.

In summary, the phenomenon of mutual regard between mother and infant appears to play a very important role in the overall mother-infant interaction. Also, recent research by Stern (1974) indicates that mutual regard accounts for a fairly extensive percentage of the interaction time. Further information is needed regarding variables which may influence mutual regard between mothers and infants.

Visual Co-orientation

In one of the few examination of visual co-orientation, Collis and Schaffer (1975) note the pervasive tendency of researchers to emphasize "eye contact"; however, they assert that, particularly in the prelinguistic period visual interaction is more likely to be "indirect" (i.e., joint attention to environmental features) than face-to-face. Collis and Schaffer examined the extent to which this phenomenon occurs between mothers and their infants; two infant age groups were included (19-27 weeks and 45-62 weeks). Frame-by-frame analysis indicated that infants spent on the average 42% of the time visually fixating toys which has been supplied in the setting, and much of the remaining time looking elsewhere around the room. Also, although in general the mothers looked at the toys less than their babies, there was a significant correlation between the time infants and mothers looked at toys; further, when simultaneous toy-looking occurred, it was typically at the same toy. Comparing the "visual following" of mothers and infants, in all but two cases, the mother showed a significant tendency to follow her infant's gaze to a particular toy; only once did an infant do so. No differences were observed as a result of infant age.

Little is known about the infant's tendency to follow maternal visual regard. Although Scaife and Bruner (1975) demonstrated in a laboratory situation that infants as young as 4 months of age would look in a similar direction as an adult who shifted his gaze (with most infants demonstrating this behavior by 9 months), these investigators used a male experimenter instead of the infants' mothers. Clearly, more naturalistic research between mothers and infants needs to be performed if this issue is to be clarified.

Mother-Infant Visual Behaviors and Communication Development

Very little literature on the relationship between mother-infant visual behaviors and communication development exists. Perhaps the first reference to this relationship was made by Collis and Schaffer (1975). Commenting upon visual co-orientation to an object by mother and infant, these authors noted that frequently once this visual co-orientation was established, the mother would point to the toy and either comment upon it or label it. Such observations would indicate that this type of situation has great potential for infants to learn various labels for objects.

In an elaboration of this study, Collis (1977) more specifically looked at vocalizations which occurred as a result of visual co-orientation. Using 8 mothers and their infants, aged 40-46 weeks, Collis examined the occurrence of labelling following visual co-orientation in a laboratory setting. His results indicated that the number of labelling occurrences was very small, but that when naming did occur, infants were more likely to be looking at the labelled object. From these results, Collis concluded that visual co-orientation to objects could serve as a context for vocal exchange.

Practically nothing exists regarding the occurrence of vocalizations as a result of mutual gaze between mother and infant. Schaffer, Collis, and Parsons (1977) examined the coordination of looking patterns with vocalizations within the mother-infant dyad. However, this study primarily involved the frequency with which mothers or infants were looking at each other while vocalizing. Clearly, such an approach cannot resolve the function of mutual gaze in initiating communicative behaviors. To this point, no one has reported upon this function of mutual gaze.

Statement of the Problem and Hypotheses

The preceding review of the literature reveals that many questions remain regarding the occurrence of different visual modes within mother-infant interaction, as well as the ways in which these modes influence communication between a mother and infant. In attempting to address some of these questions, the present research had several intentions, the first of which was the demonstration of both mutual gaze and visual co-orientation within the same mother-infant pairs. A second purpose involved investigating the occurrence and types of communicatory behaviors which are emitted by the mother and infant during periods of mutual gaze and visual co-orientation. Finally, the effects of infant sex, infant cognitive level, and maternal sensitivity, both upon these visual interactions and their accompanying vocalizations, were assessed.

Two-four month-old infants in the second and third sensorimotor stages and their mothers, who were classified as sensitive or insensitive, participated in the study. In order to examine each visual mode as independently as possible, two 5-minute videotaped sessions were conducted, each of which was intended to enhance the occurrence of one of these modes. For example, during the first session, mothers and infants were filmed by themselves in an unstructured (i.e., without toys) situation. A second session was then taped, during which the mother and infant were filmed through a plexiglass sheet, on which were mounted various toys--in this way maternal and infant visual co-orientation to the objects could be monitored. Tapes were later coded as to the occurrence of mutual regard and visual co-orientation episodes, as well as the vocalization/gestures which occurred within each of these episodes.

In light of the scanty data base which exists regarding the effects of infant sex and cognitive level or maternal sensitivity upon visual interaction behaviors, it was not possible to make comprehensive predictions of results. However, previous information did allow the formation of several specific hypotheses regarding the outcome of this study. First, since previous research (e.g., Brazelton *et al*., 1974) has consistently failed to report sex differences in mutual regard episodes, it was expected that infant sex would not differentially affect mutual gaze. In addition, although much less is known regarding visual co-orientation in general, pertinent studies (e.g., Collis & Schaffer, 1975) have not reported sex differences in this behavior; therefore, none were expected in the present study.

With regard to maternal sensitivity, it was expected that this factor would influence the visual behaviors exhibited by this sample of mothers and infants. While data directly addressing this issue are not currently available, the information provided by Stern (1971) and Brazelton *et al*., (1974) suggest that increased maternal sensitivity results in more infant visual regard. Mutual regard was therefore expected to be more characteristic of the high sensitivity mother-infant pairs in the present sample. Further, a similar hypothesis was proposed for visual co-orientation episodes, with higher sensitivity mother-infant pairs expected to engage in more visual co-orientation.

In contrast, infant cognitive level was not expected to influence either mutual regard or visual co-orientation between these mothers and infants. As with maternal sensitivity, no one has expressly addressed this issue. However, some possibly relevant information has been provided by Ling and Ling (1974), who, comparing different communicative behaviors between mothers and infants across the first three years of life, reported that no changes occurred in the frequency of eye contact during this period. Again as with maternal sensitivity, it was proposed that visual co-orientation behaviors would follow the pattern of mutual gaze measures, in that cognitive level would not affect these former measures.

Additional hypotheses regarding visual interaction behaviors concerned the initiation and termination of mutual gaze and visual co-orientation. Specifically, it was expected that infants would initiate and terminate more mutual gaze episodes; such hypotheses were founded upon the consistent findings reported by previous researchers regarding those events (e.g., Fogel, 1977; Stern, 1974). In addition, these same patterns were expected to hold for the initiation and termination of visual co-orientation episodes.

The second group of hypotheses to be tested was those concerning the occurrence of communication acts following the establishment of mutual gaze and visual co-orientation episodes. First, it was expected that infant sex would not significantly affect the occurrence of communication during either of these visual modes; such an expectation was based largely upon the absence of sex differences in communication development in very young infants (e.g., Maccoby and Jacklin, 1974).

However, maternal sensitivity was expected to exert an influence on these communicative behaviors, with more such behaviors being observed within the mutual gaze and visual-co-orientation of infants and high sensitivity mothers. Again, data have not been provided as to this issue; these hypotheses, then, probably for the most part reflect the emphasis placed by the present research upon the importance of social interaction to mother and infant behaviors.

With regard to the infant cognition factor, very few data exist which are relevant to infants this age. However, Bates et al. (1974), utilizing 9½-10½ month-olds, reported very low correlations between cognition and communication. Therefore, it was posited that in the present research infant cognition would not differentially influence the frequency of communicatory acts between mothers and their infants. However, it was hypothesized that, with increasing cognitive level, mothers would utilize different modes of communication-specifically, mothers of sensorimotor stage 2 infants were expected to utilize more gestures than vocalizations, and that this pattern would reverse itself in mothers of sensorimotor Stage 3 infants. This hypothesis was founded upon the work of Ling and Ling (1974), who reported that, with increases in infant age, mothers in communication with their infants were observed to switch from actions and body posture modes to vocal and verbal modes. Compatible with this expectation was an additional hypothesis in the present study, namely that mothers of Stage 3 infants would emit relatively more higher-level vocalizations (e.g., declarations and questions as opposed to monosyllabic utterances) than the mothers of Stage 2 infants.

Finally, hypotheses were offered concerning the initiation of communicative sequences following the establishment of mutual regard or visual co-orientation. Specifically, it was expected that mothers would be more likely than infants to initiate these sequences following the onset of each of the visual modes. In previous research, Fogel (1977) has reported upon the significantly high co-occurrence of mutual gaze between mothers and infants and maternal vocalizations. As with previous hypotheses, this same pattern was expected to also be demonstrated during periods of visual co-orientation in the present study.

Method

Subjects

Names of possible subjects for the present study were obtained from newspaper birth announcements. Subjects were recruited through telephone contact, with 71% of those who were contacted agreeing to participate in the study. Upon initial contact, it was ascertained that the infant had been full-term, and had experienced no serious complications since birth; only infants meeting these conditions were included in the study.

A total of 47 infants (22 males, 25 females) and their mothers participated in the study. However, data from two mother-daughter pairs were excluded due to either infant fussiness and/or equipment failure. In addition, five infants (2 males, 3 females) were eliminated due to the fact that they were performing at a cognitive level considerably below comparably-aged infants. Therefore, the final sample consisted of 40 infants, 20 males and 20 females, and their mothers. The infants of each sex were evenly divided between Piaget's (1952) second and third sensorimotor substages. Stage 2 infants' ages ranged from 8-11 weeks ($\bar{x}$ = 10.1 weeks), while ages of Stage 3 infants ranged from 16-18 weeks ($\bar{x}$ = 17.2 weeks). Also, 55% of the mothers breastfed their infants, while 45% bottle-fed their infants. Finally, 42% of these mothers were primiparous, with the remaining 58% being multiparous.

Measures

Cognitive stage measures. Infant cognitive level was determined through the administration of the Urgiris-Hunt (1975) Ordinal Scales, which are based upon Piaget's (1952) theory of cognitive development. These scales include "The development of visual pursuit and the permanence of objects," "The development of means for obtaining desired environmental events," "The development of imitation: Vocal and gestural," "The development of operational causality," "The construction of object relations in space," and "The development of schemes for relating to objects." For 34 of the 40 infants (80%) included in the final sample, the researcher and a second observer administered and scored all subscales; for the remaining six subjects, the researcher administered the scales alone. Interobserver reliability (for those 36 subjects on which this information was available) was calculated for each infant by counting the number of items which the researcher and observer scored identically and dividing by the total number of items administered. Mean reliability was 91% for the Uzgiris-Hunt scales (range = 73% to 100%).

Infants' performance on the subscales was used to determine their cognitive stages. Although all scales were administered, examination of the samples' overall performance revealed that, in such a young infant sample, the primary differentiator of cognitive level consisted of the presence/absence of secondary circular reactions and the achievement of visually directed grasping (as measured by "The development of means for obtaining desired environmental events" subscale) and the exhibition of "procedures" (as measured by "The development of operational causality" subscale). Simply defined, procedures refer to the performance by the infant of a consistent behavior following a spectacle produced by the tester; for example, an infant might consistently make an "ah" sound after the tester had started and stopped a pinwheel very quickly. In the present study, while Stage 3 infants were capable of bringing their hands to an object and grasping it, performing secondary circular reactions, and exhibiting procedures, Stage 2 infants were not. These observations suggest that future research might utilize only these two subscales when dealing with infants this young. In the current sample, only those infants who were in the second or third sensorimotor substages were included.

Maternal sensitivity measures. In order to classify mothers as to sensitivity, the DeMeis (1977) revision of the maternal sensitivity scale devised by Ainsworth, Bell and Stayton (1974) was utilized. According to Ainsworth et al., there are four primary dimensions of maternal sensitivity: (1) maternal awareness of infants' signals; (2) accurate interpretation by the mother of those signals; (3) appropriate maternal responsiveness to the signals; and, (4) prompt maternal responsiveness to these signals. In addition, each dimension has different components-for example, correct maternal interpretation of infant signals is thought to consist of maternal accessibility to signals, maternal freedom from distorting signals, and maternal empathy. In her revision, DeMeis (1977) devised a 5-point item measuring each of the components of each dimension; further, if two or more items measured overlapping areas, items were removed until only one of the items remained. Such a procedure resulted in the six items appearing in Appendix A (also included is a sample coding sheet). By assigning a value of 1-5 to these items (with a higher score signifying a more sensitive response), a total score of 30 is possible for each mother-infant pair. An additional revision was made by the present author; specifically, an additional five points were made possible by assigning one point for each of the behaviors in Item 2 which were responded to by mothers. To illustrate, a mother who responded to infant body stilling/movements and gaze aversion/contact would receive a "5" (conceivably the most "sensitive" score); however, she would only receive a "2" with regard to the number of infant behaviors responded to overall. This procedure enables the differentiation of mothers who respond only to body movements/stilling and those mothers who respond to additional behaviors.

In the original proposal of the current research, the assessment of maternal sensitivity was to take place in the first three minutes of observing the mother and infant in the home. Re-evaluation of this tactic suggested that this period was too short of a time on which to base this assessment. It was therefore decided that, in addition to this assessment, an independent assessment would be made during the later coding of the videotaped sessions. Comparisons of these two assessments for each mother-infant pair revealed that some changes occurred, with 55% of the mothers "switching" sensitivity groups. However, an examination of these cases indicated that these changes could not be attributed to any unreliability in the sensitivity scale. Rather, it appeared that the videotaped segment provided a wider range of behaviors, both infant and maternal, on which to base a judgment. To illustrate, it was very common for infants not to become upset during the 3-minute home observation (which always took place at the beginning of the experimental session, when the infant was not as likely to be fussy); clearly, such a situation made it extremely difficult to judge the items on the checklist which are meant to assess mothers promptness in responding to their infants and, also, the efficacy with which they satisfy their infants (i.e., Items 5 and 6).

Since it was clear that more representative behaviors could be observed in the videotape segments, the decision was made to base the classification of the final sample as to maternal sensitivity upon the videotape observations, and not the home observations. Coders were instructed, therefore, to rate maternal sensitivity when analysing the videotapes for visual and vocal behaviors. Interobserver reliability was calculated by dividing the number of agreements regarding each item by the total number of observed items. Mean reliability for all mother-infant pairs exceeded 80%. Finally, in classifying the final sample as to maternal sensitivity, a median split procedure was employed, utilizing mothers' total sensitivity index; in this manner, low and high sensitivity mother-infant pairs were determined.

Procedure

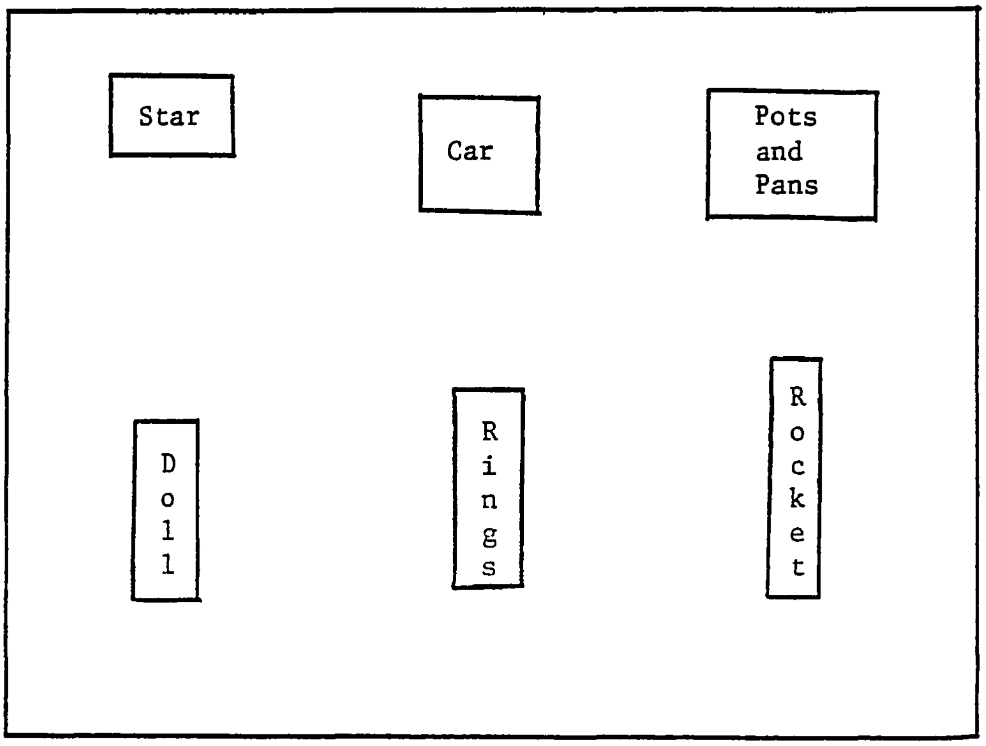
In order to capture as naturalistic an interaction as possible between mothers and their infants, the experimental procedure was conducted in the subjects' homes. This procedure consisted of three sessions. For the first session, mothers and infants were observed for three minutes in unstructured play (i.e., without toys); the mothers were told that the purpose of this period was to get her and her infant used to the observers. During this time, the researcher and a naive observer scored the maternal sensitivity scale.

Following this initial session two five-minute videotapes were made. For the first five minutes, the mother-infant pairs were taped in an unstructured situation, without the benefit of toys, objects, or other people. For the second five minutes, the mother and infant were given a 3 ft. X 3 ft. plexiglass board on which six well-placed toys were bolted; Table 1 includes a schematic representation of this toy-board. This board was set up in front of the mother-infant pair while the camera for this session was set up behind the board; such positioning made it possible to tape through the plexiglass board, allowing the detection of visual co-orientation by the mothers and infants to the objects. Finally, following these videotape sessions, the Uzgiris-Hunt (1975) scales were administered.

In the majority of the cases, this entire procedure took less than one hour, making it possible to collect all data on each mother-infant pair on the same day. However, for some pairs, it was necessary to arrange a second visit; this necessity was for the most part due to infant fussiness (particularly with the 2 month-old group), which made completion of the data collection impossible or, at best, non-optimal. In such cases, mothers were asked regarding the feasibility of the researcher returning; in all cases, the mothers agreed. In order to control for too much time elapsing between the visits, one condition was set; specifically, return visits had to be made within four days. Such an arrangement was possible for all but one mother-infant pair who required an extra visit. Of the 40 pairs of mothers and infants who were included in the final data sample, return visits had to be arranged

Table 1

Schematic of Toyboard



in 23% of the cases. In addition, the split in procedure was such that taping was done in one session, with the cognitive assessment being performed during the other session.

Following the completion of data collection for each mother-infant pair, mothers were debriefed as to the general purposes of the study; also, the meaning of the cognitive assessment was thoroughly explained, with particular emphasis placed upon each infant's performance.

Videotape Analysis

Prior to data analysis, a time overlay was added to each videotape which marked time to a hundredth of a second; this overlay made it possible to allow coders to note the times at which specified events occurred. In the original proposal of the current research, it had been planned that the unstructured segment videotape would be coded specifically as to the occurrence of mutual regard, while the structured segment tape was to be coded for the occurrence of visual co-orientation behaviors. However, it became obvious during the early stages of the coding process that some instances of visual co-orientation had occurred during the unstructured episode (e.g., mother might follow her infant's gaze to the infant's foot or the mother's hand); similarly, some occurrences of mutual gaze were observed during the toyboard session. The overall frequency of such occurrences was very small (3%); with the majority of each visual interaction behavior observed during the "correct" session. However, it was thought that all instances of these behaviors should be coded; therefore, coders were instructed to do so, regardless of the session in which visual behaviors occurred. Similarly, later data analyses included visual co-orientation and mutual gaze episodes across sessions.

Tapes were coded by two trained independent observers. Coding was accomplished by noting, using special coding sheets, the occurrence of each visual behavior episode. An example of this coding sheet may be seen in Appendix B. As demonstrated, this sheet made it possible for the observers to mark the time of the initiation, visual following, and termination for each of these episodes, as well as the initiator and terminator of each episode. (Previous literature has traditionally treated as the initiator of a visual episode the partner who returns the other's gaze. However, since the current research was concerned with additional issues such as latency, the initiator of a visual episode was defined as the partner who looked first at the other (mutual gaze) or at the target object (visual co-orientation); the follower, then, was the partner who "joined" the other's gaze (e.g., the initiator in previous research)). Interobserver reliability for the occurrence of mutual regard and visual co-orientation episodes exceeded 79% for all mother-infant pairs.

With regard to communication behaviors, coders noted for each visual episode all maternal and infant vocalizations and/or gestures. In order to assess the visual modes as to their facilitatory role to communication, only those vocal or gestural behaviors which were judged to begin following the establishment of the visual modes were recorded. Interobserver reliability regarding the occurrence of these communicatory acts was 80% for mutual regard episodes and 88% during periods of visual co-orientation. In addition, interobserver reliability was computed for who had initiated/terminated each episode. For mutual regard, these respective reliabilities were 80% and 92%; for visual co-orientation, these reliabilities were 84% and 75%, respectively.

In compiling data, two sets of dependent measures were derived from the coders' observations, one involving visual behaviors and the other specific to communication behaviors. With regard to the visual behaviors, the frequency, duration and latency of each visual episode were computed; in addition, frequency of maternal and infant initiations/terminations was compiled. Concerning communication behaviors, the frequency of maternal and infant vocalization/gestures were computed; further, maternal vocalizations were classified as either a non-verbal utterance (e.g., "Ah"), label (e.g., baby's name, toy name), question (e.g., "What are you looking at?") or declaration ("You sure are a pretty baby."). Infant vocalizations were categorized as either positive or negative. Finally, the occurrence of mother and infant initiations of communicative sequences following the establishment of mutual gaze and visual co-orientation was tabulated.

The original proposal for this study had intended to utilize all of the above measures in data analyses. However, after compilation, some changes in original conceptualizations were necessitated, largely due to a tendency for several of the measures to occur very infrequently. These behaviors consisted of the following: maternal and infant gestures during both visual sessions; maternal monosyllabic utterances; maternal use of labels during mutual gaze (indicating that the mothers rarely called their infants by their names when in an _en face_ position); negative infant vocalizations (reflecting the experimental condition that infants be in a good mood during the sessions); and, total infant vocalizations during visual co-orientation. Since it was assumed that the skewed distributions of these variables would lead to suspect findings, changes were made. First, maternal/infant gestures, maternal monosyllabic utterances, and maternal label usage during mutual gaze were discarded from analysis; similarly, only maternal vocalizations were analyzed during visual co-orientation episodes. A second change involved combining both positive and negative infant vocalizations during the mutual gaze sequences.

A final modification in original conceptualization concerned the number of dependent measures to be utilized in analyzing visual interaction episodes. Initially, the frequency of these episodes and the average duration of the episodes were to be included, as well as maternal latency, infant latency, and maternal and infant terminations and initiations. However, an examination of the data indicated that the frequency and average duration measures yielded highly redundant information. Therefore, it was decided to omit the frequency measure.

Summary

The purpose of this study was to measure the effects of infant sex, infant cognitive stage, and maternal sensitivity upon the occurrence of mutual regard and visual co-orientation sequences between mothers and their 2-4 month-old infants. Infants from two substages of sensorimotor development, the second and third, participated in the study; the infants of each substage were evenly divided between males and females. Mothers of these infants were classified as sensitive or insensitive. Mother-infant pairs were videotaped under two conditions, each of which enhanced the occurrence of mutual gaze and visual co-orientation, respectively. The design of the study may be found in Table 2. In compiling observations, all mutual regard and visual co-orientation episodes (regardless of the experimental session in which they occurred) were recorded. Dependent measures for these episodes included: latency, average duration, maternal/infant initiations, and maternal/infant terminations. For the communication behaviors, the following dependent measures were utilized: maternal labels (for the visual co-orientation episode only), maternal declarations, maternal questions, and total infant vocalizations (during the mutual gaze episode only).

Table 2

Design of Study

	Maternal Sensitivity			
Cognitive Abilities	High		Low	
	Male	Female	Male	Female
Stage 2	5	5	5	5
Stage 3	5	5	5	5

Results

Description of Analyses

The present study was intended to provide descriptive information regarding the occurrence of mutual gaze and visual co-orientation within mother-infant pairs, as well as to examine the effects of specific variables upon these visual interactions and their accompanying communicative behaviors. Analyses included the computation of conditional probabilities in assessing the likelihood that infants and mothers initiated/terminated mutual gaze or visual co-orientation episodes; similar computations were used in determining the probability that mothers and infants initiated communication following the establishment of the two visual modes. In addition, a correlational analysis (not included in the original proposal of the study) was performed, in order to examine possible relationships between visual co-orientation and mutual gaze (and subsequent vocalizations) within the same mother-infant pairs. Finally, two primary sets of multivariate analyses of variance were utilized in analyzing the majority of the data. Four such analyses were performed, a separate one for mutual gaze and visual co-orientation measures, as well as one each for the communicatory behaviors occurring in both visual interaction episodes. All of the raw data from the present study may be found in Appendix C.

In the present section, the descriptive statistics regarding the present study's data are given, including the conditional probability results and the correlational analysis results. Following that presentation, the analyses of the visual interaction behaviors and the communication measures, respectively, will be discussed.

Descriptive Measures

The present section is intended to present the descriptive measures regarding the data obtained in the current study, in addition to documenting the ways in which the two visual modes of interest were related within mother-infant pairs; as mentioned previously this latter information has not been provided by previous research.

With regard to visual interaction behaviors, the mothers and infants in the present study spent 43% of their time in mutual regard while only 21% of the total time was spent in visual co-orientation. Further observations revealed that, although there were, on the average, more visual co-orientation episodes per mother-infant pair ($\bar{x}$ = 31) than mutual gaze episodes ($\bar{x}$ - 22), the mean average durations of these different episodes were quite discrepant. Specifically, the mean length of a mutual regard episode was 7.38 seconds, while this measure for visual co-orientation was only 2.32 seconds.

Table 3 presents the conditional probabilities regarding the number of maternal and infant initiations and terminations of visual episodes. As can be seen, an interesting pattern emerged in the comparisons of the two visual modes along these dimensions. For example, mothers during the mutual gaze sequences were much more likely to

Table 3

Conditional Probabilities-Maternal and Infant Initiations and Terminations of Visual Interactions

	Initiations	Terminations
Mother	.66	.29
Infant	.18	.65

Mutual Gaze

	Initiations	Terminations
Mother	.14	.81
Infant	.72	.19

Visual Co-Orientation

Note. Numbers in the table indicate the probability that mothers or infants initiated/terminated a visual episode given the occurrence of that episode. For example, the .29 value given for the maternal terminations of mutual gaze mean that there was a .29 probability that mothers were the terminators of mutual gaze interactions.

initiate (i.e., look at the infant before the infant was looking at her) these sequences, while infants terminated the vast majority of these sequences. However, this initiation-termination pattern reversed itself in the visual co-orientation episodes. As shown in the table, it was the infants who were more likely to initiate these episodes, while the mothers were four times more likely to terminate visual co-orientation than the infants. A more detailed representation of these conditional probabilities as grouped by infant sex, maternal sensitivity, and cognitive level may be found in Appendix D.

Another intriguing pattern was observed when comparing maternal and infant latencies (i.e., the amount of time it took for either partner to follow the other's gaze); this pattern is depicted in Table 4. As shown, mothers required less than a second to establish eye contact with their infants once the infants had gazed at them; however, during visual co-orientation sequences, this latency more than quintupled. An opposite pattern was observed in infant latency behaviors; specifically, infants were seven times faster in responding to a maternal glance towards an object than to a maternal glance at the infant.

A descriptive summary of communication behaviors following visual co-orientation and mutual gaze is given in Table 5. As the table shows, total maternal vocalizations were similar during the two sessions; however, labels were found to increase dramatically in the visual co-orientation session compared to the mutual regard episodes, while declarations decreased. Concerning infant vocalizations, it was observed that, as alluded to above, infant vocalizations were much more frequently occurring in the mutual gaze episodes.

Table 4

Average Maternal and Infant Latencies in Seconds-
Visual Episodes

	Mutual Gaze	Visual Co-Orientation
Mother	.84	5.61
Infant	7.08	1.46

Table 5

Average Number of Vocalizations-
Mutual Gaze and Visual Co-Orientation Episodes

	Labels	Questions	Declarations	Total
Mutual Gaze	.15	4.78	10.00	14.98
Visual Co-Orientation	2.42	6.10	7.52	16.17

Mother

	Positive	Negative	Total
Mutual Gaze	5.25	1.35	6.80
Co-Orientation	1.80	.88	2.70

Infant

Table 6 includes the conditional probabilities regarding the initiation by mothers and infants of communication sequences following the establishment of mutual gaze and visual co-orientation. As this table demonstrates, mothers were considerably more likely than infants to vocalize following the establishment of both types of visual interactions. Comparing the two visual modes, it can be seen that for both mothers and infants, the probability of a vocal initiation was lower during visual co-orientation relative to mutual gaze--therefore, there were less visual co-orientation episodes overall in which vocalizations took place as compared to mutual gaze episodes. As with visual initiations and terminations, a more detailed account of conditional probabilities as to infant/maternal initiations may be found in Appendix E.

As the descriptive measures detailed above would seem to indicate, no clear relationship between mutual gaze and visual co-orientation behaviors was evidenced in the present study; likewise, the vocalizations occurring within the duration of these visual episodes appeared to be unrelated. Pearson Product Moment Correlation analyses were performed in order to examine this issue further. These analyses confirmed the impression provided by the descriptive measures, as, for the most part, no significant correlations were observed between either visual or vocal behaviors during the two episodes. For example, total time spent in mutual gaze was not correlated to the total time spent in visual co-orientation by these mother-infant pairs. Similarly, none of the vocal behaviors emitted during mutual gaze periods were significantly related to those vocalizations observed during visual co-orientation.

Table 6

Conditional Probabilities-Maternal and Infant Initiations of Communication Following Visual Interaction

	Mutual Gaze	Visual Co-Orientation
Mother	.69	.50
Infant	.09	.04

Note. Numbers in the table indicate the probability that mothers or infants vocalized first given a visual episode. For example, the .69 value given for maternal initiations of a communication sequence during mutual gaze means that there was a .69 probability that mothers spoke first following the establishment of mutual gaze.

Analyses of Visual Behaviors

In analyzing the mutual regard behaviors obtained from the current sample, a 2 (Infant Sex) X 2 (Maternal Sensitivity) X 2 (Infant Cognitive Level) multivariate analysis of variance was performed on the following dependent measures: average duration of each mutual gaze episode, maternal latency in following mutual gaze, infant latency in following mutual gaze, number of maternal initiations of mutual gaze, number of infant initiations of mutual gaze, number of maternal terminations of mutual gaze, and number of infant terminations of mutual gaze. The descriptive statistics of these measures by sex, cognitive level, and maternal sensitivity are provided in Table 7.

Results of this analyses revealed a significant effect of infant cognition, $F\ (7, 26)\quad 4.32$, $p < .003$. (Because all factors in the multivariate analyses utilized in the present study consisted of only two levels, the criteria for these analyses-the Hotelling-Lawley Trace, Pillai's Trace, and Wilks' Criterion-were all distributed as exact F-values. Therefore, in reporting the multivariate results, F-ratios will be utilized.) Subsequent univariate analyses revealed that the average duration of mutual gaze was the only variable to achieve significance, $F\ (1, 39) = 9.10$, $p < .005$; as Table 7 shows, Stage 3 infants and their mothers engaged in mutual regard episodes which were more than twice the duration of these episodes between mothers and their Stage 3 infants. No other main effects achieved significance in this analysis; likewise, no two-way interactions were observed. However, a significant interaction between infant sex, maternal sensitivity, and cognitive level, $F\ (7, 26) = 3.15$, $p < .01$; subsequent univariate analyses revealed

Table 7

Mutual Gaze Measures--Means and Standard Deviations
By Sex, Sensitivity and Cognitive Level

	Maternal Initiations		Infant Initiations		Maternal Terminations		Infant Terminations	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Stage 2	13.60	8.19	4.30	4.87	5.70	5.39	12.30	7.87
Females	12.90	8.03	4.90	5.61	5.90	6.23	12.40	8.83
Low Sensitivity	14.40	10.83	1.60	.89	4.20	4.09	12.20	11.94
High Sensitivity	11.40	4.72	8.20	6.53	7.60	7.96	12.60	5.73
Males	14.30	8.72	3.70	4.23	5.50	4.74	12.20	7.27
Low Sensitivity	13.00	5.96	4.00	3.94	6.80	3.70	10.80	8.04
High Sensitivity	15.60	11.46	3.40	4.94	4.20	5.72	13.60	7.02
Stage 3	13.85	8.81	4.35	4.86	6.85	7.22	14.50	8.67
Females	16.10	10.50	5.70	4.42	9.50	7.37	17.00	10.61
Low Sensitivity	14.00	3.00	7.60	4.56	11 80	8.61	15.00	3.08
High Sensitivity	18.20	15.11	3.80	3.77	7.20	5.89	19.00	15.30
Males	11.60	6.51	3.00	5.12	4.20	6.34	12.00	5.68
Low Sensitivity	8.80	5.45	0.00	0.00	.20	.45	8.60	4.77
High Sensitivity	14.40	6.80	6.00	6.80	8.20	7.08	15.40	4.56

Table 7

Mutual Gaze Measures--Means and Standard Deviations
By Sex, Sensitivity and Cognitive Level

	Average Duration		Maternal Latency		Infant Latency	
	Mean	SD	Mean	SD	Mean	SD
Stage 2	10.60	8.85	.97	.61	5.26	4.27
Females	9.20	8.44	1.08	.67	6.08	4.98
Low Sensitivity	11.41	11.05	1.06	.89	7.85	6.80
High Sensitivity	7.00	5.10	1.10	.46	4.32	1.38
Males	11.99	9.48	.86	.57	4.43	3.48
Low Sensitivity	11.11	8.69	1.08	.67	3.65	2.05
High Sensitivity	12.87	11.16	.65	.40	5.20	4.65
Stage 3	4.16	2.30	.70	.60	8.89	9.58
Females	4.09	2.04	.90	.49	4.74	3.04
Low Sensitivity	5.44	1.62	.98	.47	3.85	1.47
High Sensitivity	2.74	1.46	.82	.56	5.63	4.09
Males	4.23	2.64	.50	.66	13.05	12.08
Low Sensitivity	2.92	.63	.00	.00	20.95	13.01
High Sensitivity	5.54	3.32	1.01	.58	5.15	1.81

that this interaction significantly influenced the occurrence of the following variables; maternal latency, $F(1, 39) = 5.42$, $p < .03$; infant latency, $F(1, 39) = 9.69$, $p < .004$; infant initiations, $F(1, 39) = 9.33$, $p < .004$; and maternal terminations, $F(1, 39) = 6.05$, $p < .002$. These interactions are depicted in Figures 1-4.

In order to further examine the nature of the interaction obtained in the present analysis, individual comparisons of cell means were performed for each of the four variables significantly affected by the interactions. To keep comparisons at a minimum (and, therefore, guard against Type I error), comparisons were made only between those cells whose means indicated that they might account for the observed interaction effect. As Table 7 shows, low sensitivity Stage 3 males and/or low sensitivity Stage 3 females consistently produced the most extreme cell means; therefore, individual comparisons between each of these cells and the other cells were made. These individual comparisons are reported for low sensitivity Stage 3 males and low sensitivity Stage 3 females in Tables 8 and 9, respectively. As an examination of these tables reveals, low sensitivity Stage 3 males were characterized by shorter maternal latency and longer infant latency for mutual gaze episodes than all other groups (this former finding loses meaning in light of the fact that infants in this group never initiated mutual gaze; therefore, mothers never were measured on latency). Also, infants in this group initiated mutual gaze significantly less than three of the other groups (high sensitivity Stage 2 females, low sensitivity Stage 3 females, high sensitivity Stage 3 males), and experienced less maternal terminations to mutual gaze than low sensitivity Stage 3 females and

FIGURE 1

Sex X Sensitivity X Cognitive Level Interaction—

Maternal Latency During Mutual Gaze

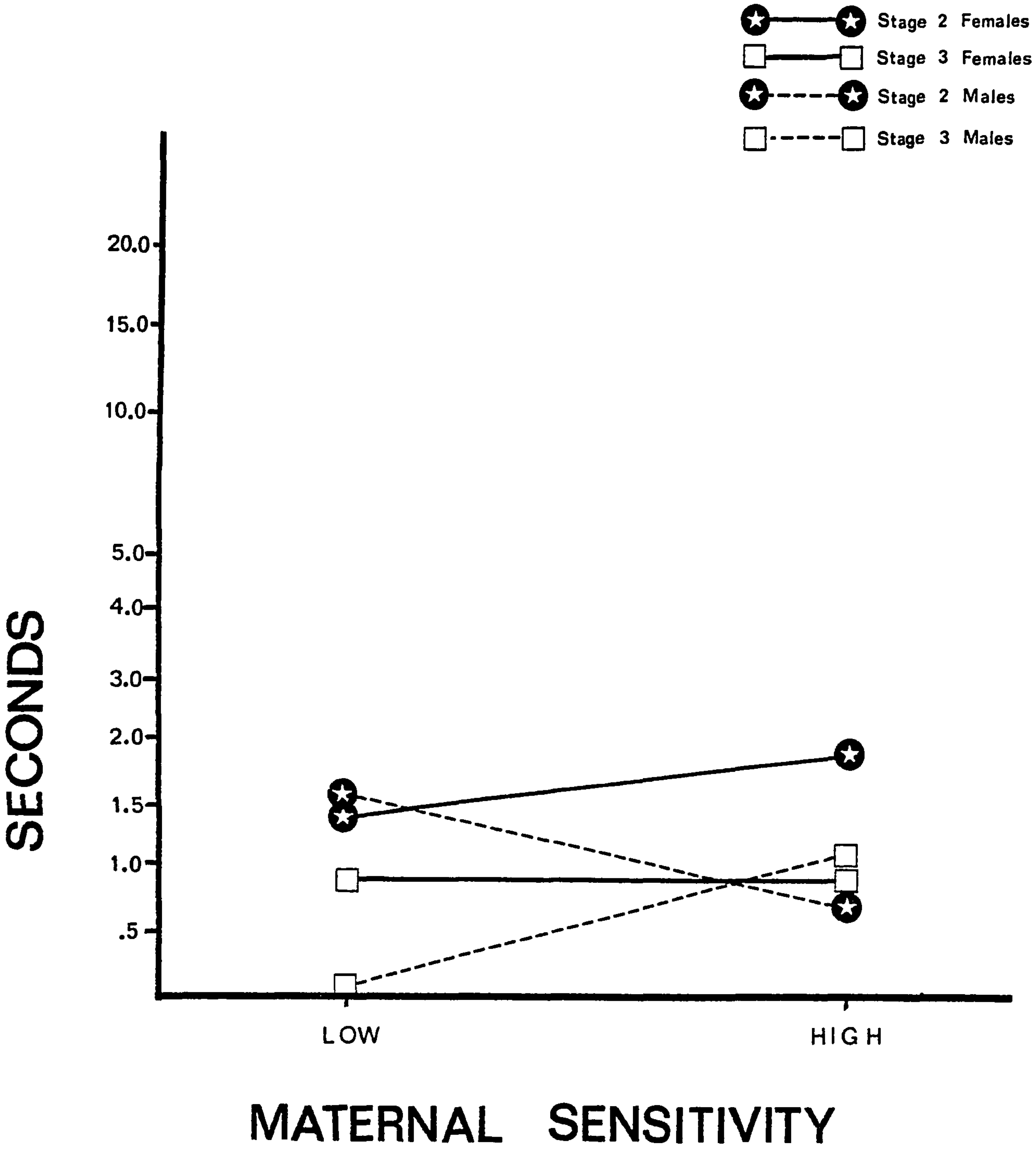


FIGURE 2

Sex X Sensitivity X Cognitive Level Interaction–

Infant Latency During Mutual Gaze

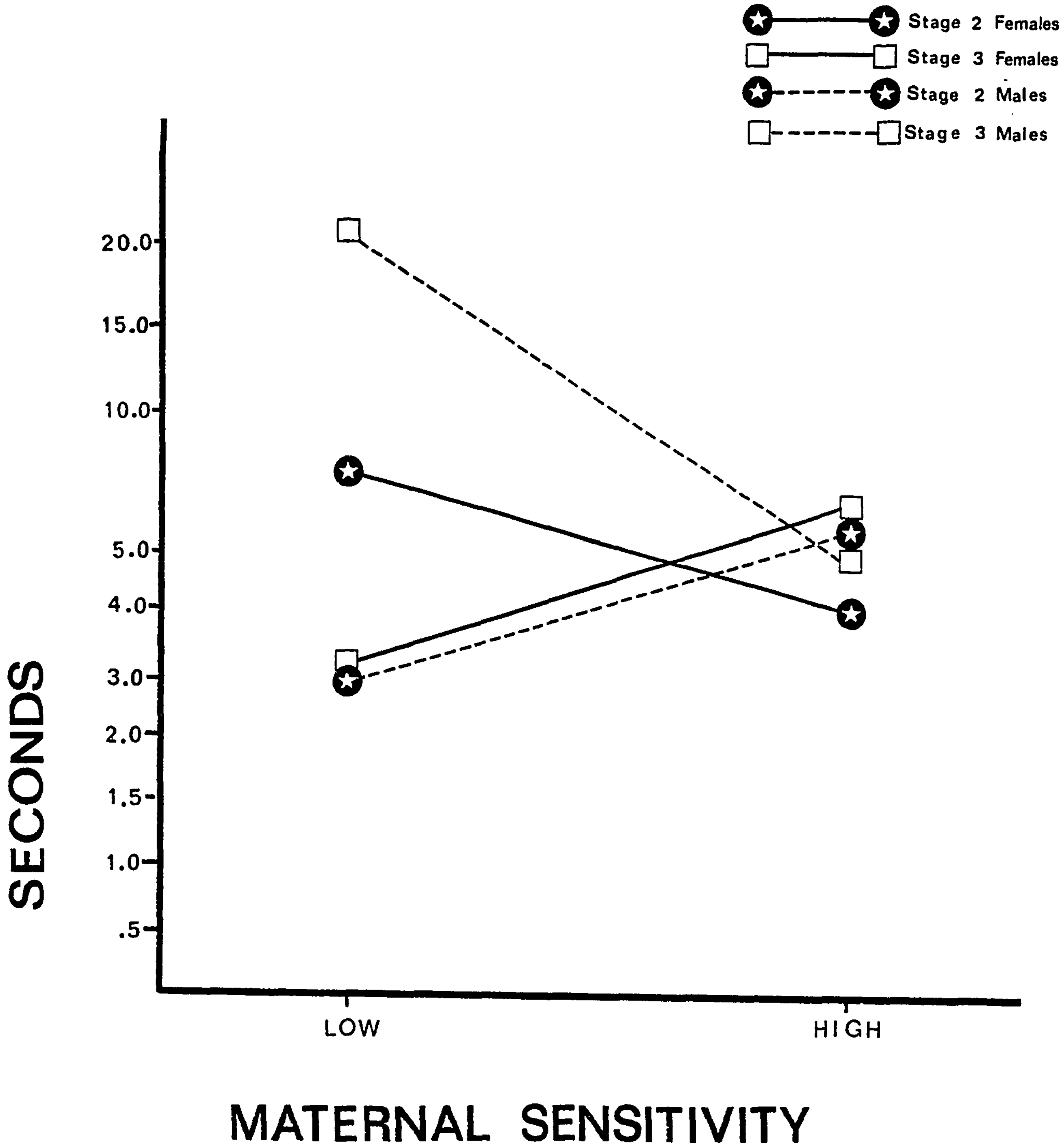


FIGURE 3

Sex X Sensitivity X Cognitive Level Interaction–

Infant Initiations of Mutual Gaze

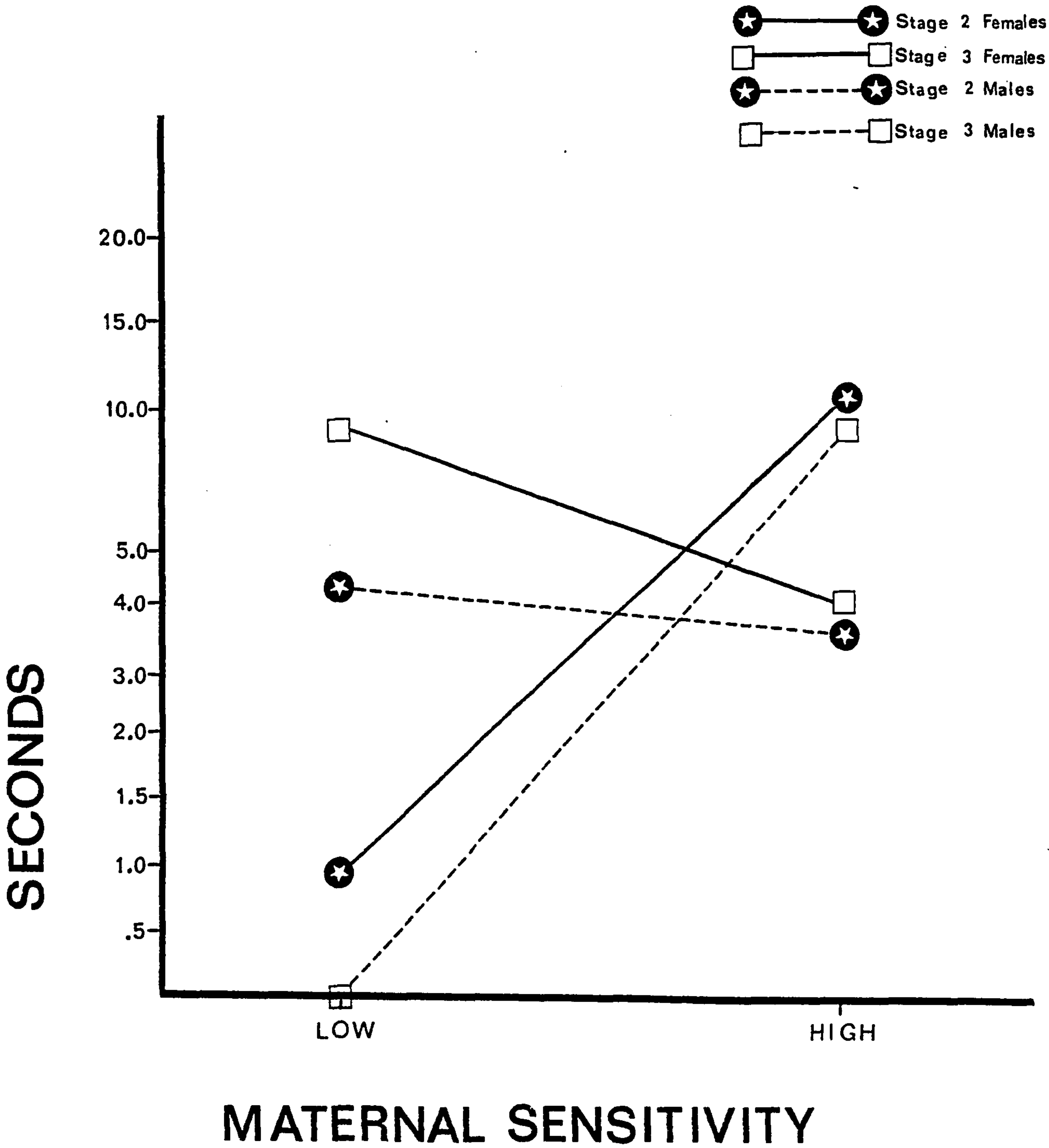


FIGURE 4

Sex X Sensitivity X Cognitive Level Interaction–

Maternal Terminations During Mutual Gaze

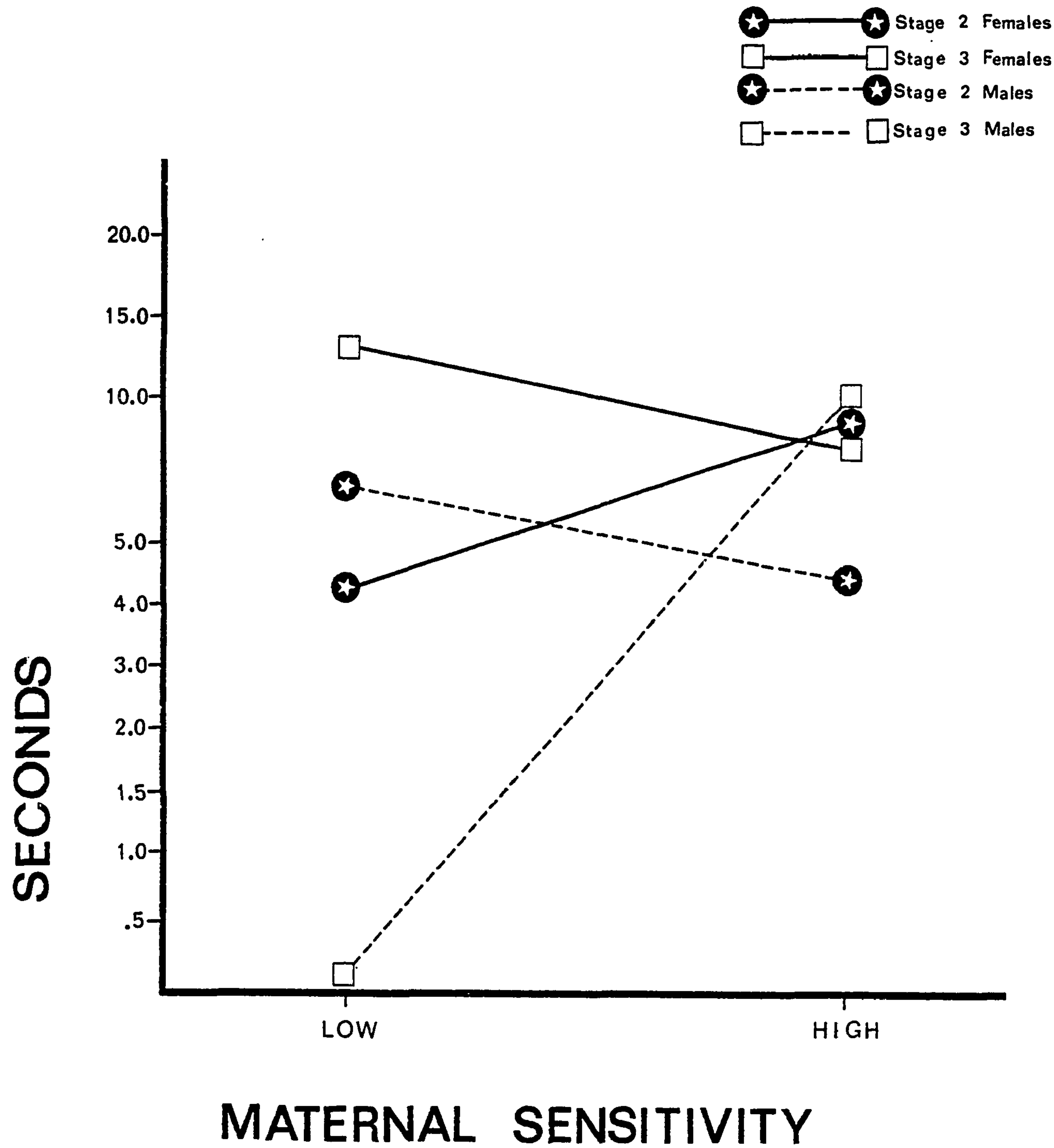


Table 8

Individual Comparisons--Mutual Gaze Behaviors
Low Sensitivity Stage 3 Male Infants

Comparison Group	Maternal Latency	Infant Latency	Infant Initiations	Maternal Terminations
Low Sensitivity Stage 2 Females	-3.01**	3.60**	- .58	-1.06
High Sensitivity Stage 2 Females	-3.13**	4.51***	-2.95*	-1.96
Low Sensitivity Stage 3 Females	-2.79**	4.70***	-2.73*	-3.07**
High Sensitivity Stage 3 Females	-2.87**	4.21***	1.37	-1.85
Low Sensitivity Stage 2 Males	-3.07**	4.75***	1.44	-1.75
High Sensitivity Stage 2 Males	-1.85	4.33***	1.22	-1.06
High Sensitivity Stage 3 Males	-2.87**	4.34***	2.16*	-2.12*

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

Table 9

Individual Comparisons--Mutual Gaze Behaviors
Low Sensitivity Stage 3 Female Infants

Comparison Group	Maternal Latency	Infant Latency	Infant Initiations	Maternal Terminations
Low Sensitivity Stage 2 Females	<1.00	1.10	2.16*	2.01
High Sensitivity Stage 2 Females	<1.00	<1.00	<1.00	1.11
High Sensitivity Stage 3 Females	<1.00	<1.00	1.37	<1.00
Low Sensitivity Stage 2 Males	<1.00	<1.00	1.29	1.32
High Sensitivity Stage 2 Males	<1.00	<1.00	1.51	1.96
Low Sensitivity Stage 3 Males	2.79**	4.70**	2.73*	3.07**
High Sensitivity Stage 3 Males	<1.00	<1.00	<1.00	1.04

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

high sensitivity Stage 3 males. While Table 9 reveals that low sensitivity Stage 3 females showed fewer significant differences with other groups than their male counterparts, an interesting pattern was observed. Specifically, this group was found in every case to significantly vary from the low sensitivity Stage 3 males. As shown, compared to these males, this group of females was characterized by longer maternal latency, shorter infant latency, more infant initiations, and more maternal terminations of mutual gaze.

To briefly summarize the results obtained in the multivariate analysis of variance with mutual gaze measures, a significant effect was found for infant cognitive level with Stage 2 infants and their mothers spending more time per episode in mutual gaze than Stage 3 infants and their mothers; cognition was also found to be involved in a complex interaction with infant sex and maternal sensitivity. Through the use of individual comparisons, it was ascertained that this interaction effect was largely due to the behaviors of low sensitivity Stage 3 males, particularly in comparison with the behaviors of low sensitivity Stage 3 females. No other main effects or interaction effects were significant.

In analyzing the visual co-orientation data, another 2 (Infant Sex) X 2 (Maternal Sensitivity) X 2 (Infant Cognition) multivariate analysis of variance was conducted, using these dependent measures: average duration of the visual co-orientation episodes, maternal latency, infant latency, maternal initiations, maternal terminations, and infant terminations. This analysis revealed no significant main effects nor interaction effects. Infant cognition, however, approached significance, $F(7, 26) = 2.30$, $p < .058$. Table 10 provides the ways that these

Table 10

Visual Co-Orientation Behaviors
Cognitive Stages 2 and 3

Measure	Stage 2		Stage 3	
	Mean	SD	Mean	SD
Average Duration	2.37	1.60	2.29	.87
Maternal Latency	3.48	1.59	2.13	.49
Infant Latency	3.46	1.53	1.68	.87
Maternal Initiation	6.05	9.68	10.80	23.58
Infant Initiation	21.80	13.65	28.10	10.69
Maternal Termination	23.60	12.44	25.45	10.49
Infant Termination	4.45	4.54	8.80	6.35

measures differed by infant cognition. Means in this table indicate that these differences were greatest when considering the number of infant terminations and the length of maternal latency. As can be seen, Stage 3 infants terminated more visual co-orientation episodes, while mothers of Stage 2 infants were slower in following their infants' gaze to objects in comparison with mothers of Stage 3 infants. Descriptive statistics on visual co-orientation measures as to cognition, infant sex, and maternal sensitivity are found in Appendix F.

Analyses of Communicative Behaviors

Two separate analyses were performed on the communication behaviors of the mothers and infants in the present study, one on those vocalizations following mutual gaze and another on those following visual co-orientation. For the mutual gaze communication, a 2 (Infant Sex) X 2 (Maternal Sensitivity) X 2 (Infant Cognitive Level) multivariate analysis was performed on the following dependent variables: maternal questions, maternal declarations, and total infant vocalizations. The summary statistics for each of these variables by sex and cognition can be found in Table 11. No main effects or interaction effects significantly affected these measures. However, the factor of infant sex approached significance, $F\ (3, 30) = 2.76$, $p < .10$. As Table 11 shows, there was a tendency for mothers to vocalize more to their female infants during mutual gaze periods. A more comprehensive representation of the vocalizations following mutual gaze are included in Appendix G.

In the analysis of communication behaviors following visual co-orientation, a 2 (Infant Sex) X 2 (Maternal Sensitivity) X 2 (Infant

Table 11

Vocalizations During Mutual Gaze
Male and Female Infants

Measure	Females		Males	
	Mean	SD	Mean	SD
Maternal Questions	6.40	4.65	3.15	2.94
Maternal Declarations	11.30	7.86	8.70	5.23
Total Infant Vocalizations	6.95	6.44	6.65	5.66

Cognitive Level) multivariate analysis was performed on these maternal vocalizations: labels, questions and declarations. The descriptive statistics for these variables are included in Table 12. Results of the multivariate analysis showed that the main effect of cognition was significant, $F(3, 30) = 3.33$, $p < .03$. Univariate analyses showed maternal questions to be significantly influenced by this factor, $F(1, 39) = 10.26$, $p < .003$; as shown by the means, mothers used questions almost twice as much with Stage 3 infants compared to Stage 2 infants during periods of visual co-orientation. Cognition also interacted significantly with infant sex to produce a two-way interaction, $F(3, 30) = 6.11$, $p < .0023$. Univariate analyses showed that each of the maternal vocalizations was affected by the interaction: labels, $F(1, 39) = 11.31$, $p < .002$; questions, $F(1, 39) = 10.81$, $p < .002$; and, declarations, $F(1, 39) = 5.89$, $p < .02$. These effects are illustrated in Figure 5; as can be seen, with increasing cognition, mothers increased each of these types of vocalizations with their female infants. However, mothers of male infants were observed to decrease each of these types of vocalizations as infant cognitive level increased.

An interaction was also observed between infant sex, maternal sensitivity, and infant cognitive level, $F(3, 30) = 7.20$, $p < .001$. Univariate measures which were affected were maternal labels, $F(1, 39) = 5.37$, $p < .03$; and, maternal declarations, $F(1, 39) = 9.06$, $p < .005$. This interaction for each of these measures is included in Figures 6-7.

As with the 3-way interaction observed on mutual gaze measures, it was decided to use individual comparisons of cell means in order to better clarify the nature of this interaction. Again as with the mutual

Table 12

Maternal Vocalizations During Visual Co-Orientation
Means and Standard Deviations By Sex
Sensitivity and Cognitive Level

	Questions		Declarations		Labels	
	Mean	SD	Mean	SD	Mean	SD
Stage 2	4.20	1.70	6.30	5.07	2.45	2.50
Females	3.50	1.96	4.40	5.08	1.20	1.55
Low Sensitivity	3.40	1.52	3.40	3.36	1.00	.71
High Sensitivity	3.60	2.51	5.40	6.66	1.40	2.19
Males	4.90	1.10	8.20	4.52	3.70	2.71
Low Sensitivity	5.00	1.22	10.80	3.82	4.60	2.41
High Sensitivity	4.80	1.09	5.60	4.16	2.80	2.95
Stage 3	8.00	6.07	8.75	5.88	2.40	2.35
Females	11.20	6.34	10.60	6.52	3.40	1.90
Low Sensitivity	8.20	2.86	13.20	4.60	4.60	1.14
High Sensitivity	14.20	7.73	8.00	7.58	2.20	1.79
Males	4.80	3.85	6.90	4.79	1.40	2.41
Low Sensitivity	4.80	4.76	3.80	3.11	.60	.89
High Ssnsitivity	4.80	3.27	10.00	4.24	2.20	3.27

FIGURE 5

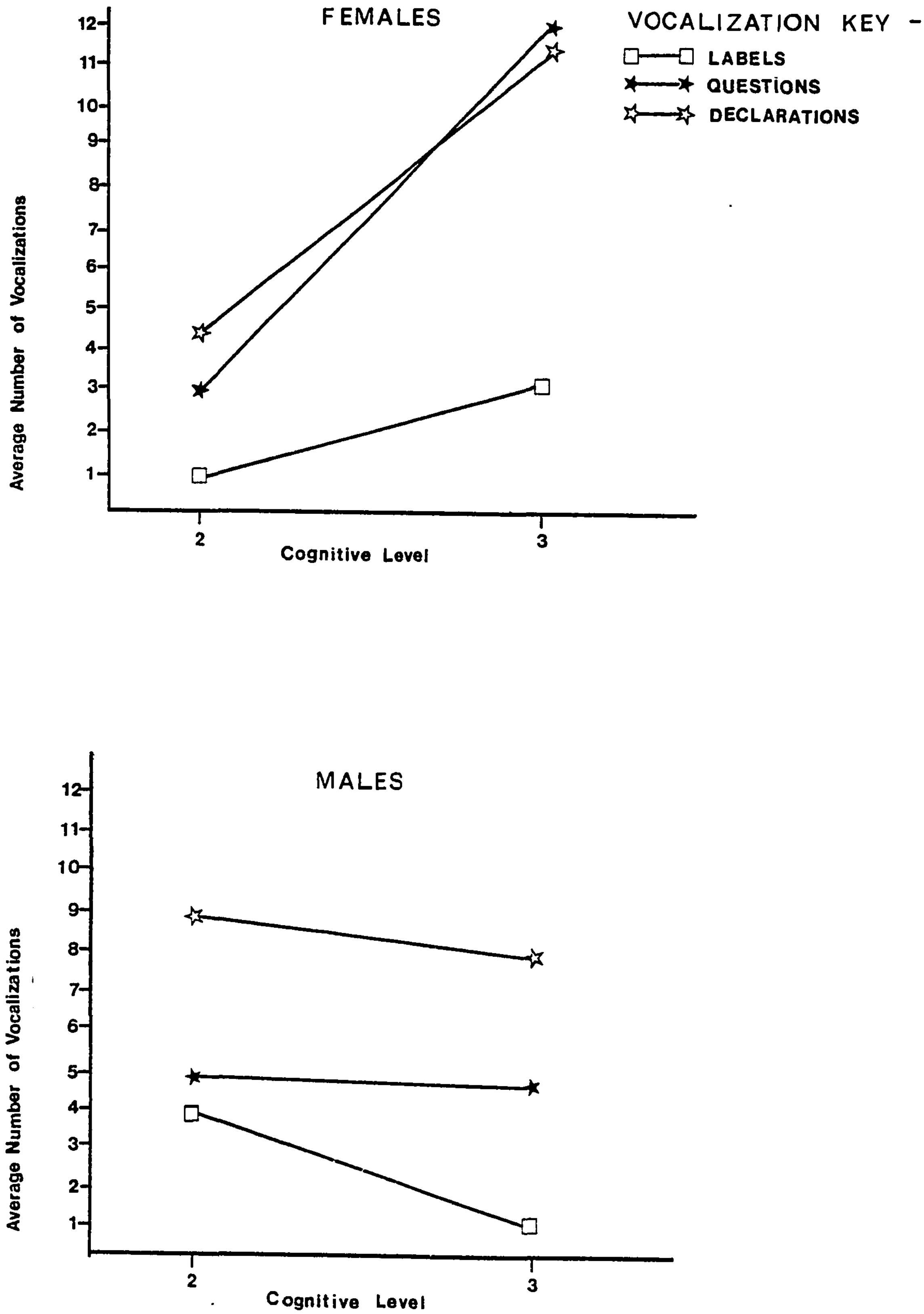

FEMALES
VOCALIZATION KEY -
LABELS
QUESTIONS
DECLARATIONS
Average Number of Vocalizations
Cognitive Level
2
3
1
2
3
4
5
6
7
8
9
10
11
12
MALES
Average Number of Vocalizations
Cognitive Level

FIGURE 6

Sex X Sensitivity X Cognitive Level Interaction

Maternal Labels During Visual Co-orientation

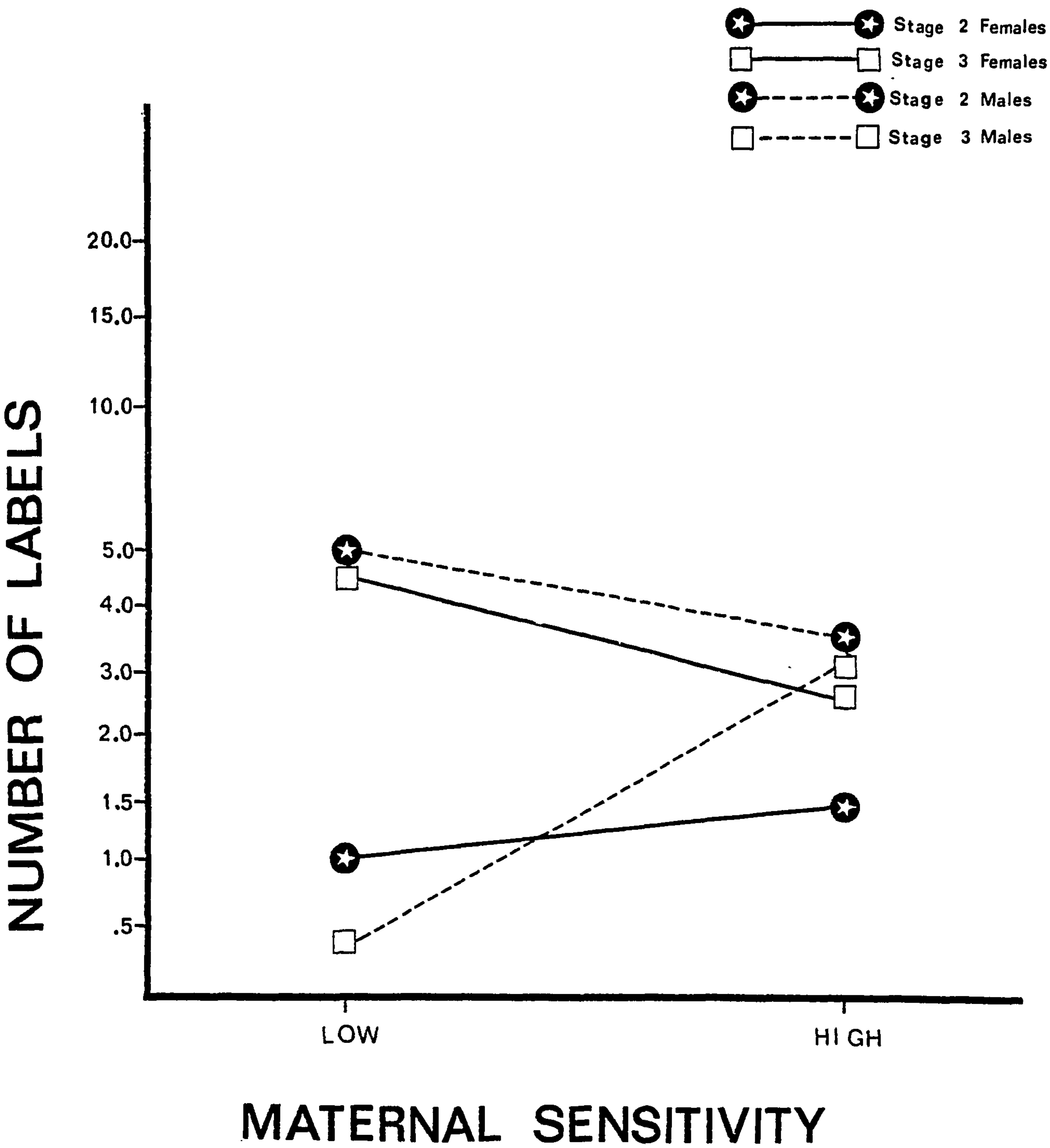
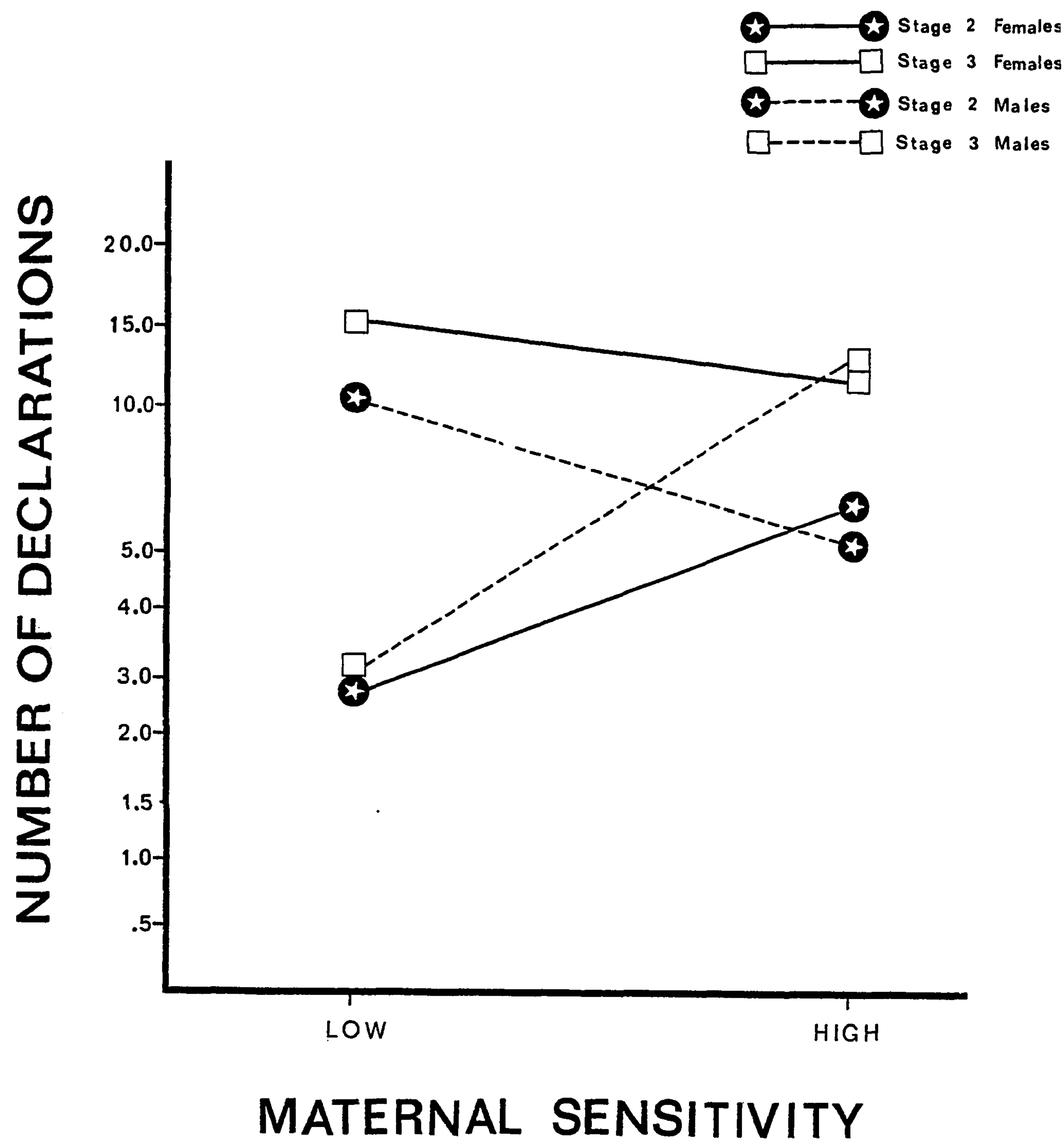


FIGURE 7

Sex X Sensitivity X Cognitive Level Interaction–

Maternal Declarations During Visual Co-orientation



gaze interaction, the two groups which seemed to account for this interaction were the low sensitivity Stage 3 males and the low sensitivity Stage 3 females; as seen in Table 12, these two groups consistently differed from each other as well as other groups. Individual comparisons therefore centered upon these two groups; these comparisons are reported in Tables 13 and 14 for the males and females, respectively. An examination of these tables show that, once more, these two groups significantly differed with each other on the occurrence of both maternal declarations and labels, with more of these vocalizations occurring within the female group. In addition, these females experienced significantly more maternal labelling and declarations than low and high sensitivity Stage 2 females, as well as more maternal declarations than high sensitivity Stage 2 males. With regard to low sensitivity Stage 3 males, mothers in this group used less labels while looking at toys than low sensitivity Stage 2 males.

To summarize the findings of this analysis, infant cognition was found to significantly influence the frequency of maternal questions following visual co-orientation. Also, a significant interaction was observed between infant sex and cognitive level regarding the dependent measures of maternal declarations, questions and label usage. Finally, an interaction was found between cognition, maternal sensitivity, and infant sex. Individual comparisons revealed that this three-way interaction effect was largely accounted for by differences between low sensitivity Stage 3 males and females; in addition, each of these groups differed from the other groups included in the study. No other main or interaction effects achieved significance in the present analysis.

Table 13

Individual Comparisons-Maternal Vocalizations
to Low Sensitivity Stage 3 Male Infants
Curing Visual Co-Orientation

Comparison Group	Maternal Labels	Maternal Declarations
Low Sensitivity Stage 2 Females	<1.00	<1.00
High Sensitivity Stage 2 Females	<1.00	<1.00
Low Sensitivity Stage 3 Females	-2.88**	-3.04**
High Sensitivity Stage 3 Females	-1.15	<1.00
Low Sensitivity Stage 2 Males	-2.88**	1.29
High Sensitivity Stage 2 Males	-1.58	<1.00
High Sensitivity Stage 3 Males	1.15	<1.00

* $p < .05$
** $p < .01$

Table 14

Individual Comparisons-Maternal Vocalizations
to Low Sensitivity Stage 3 Female Infants
During Visual Co-Orientation

Comparison Group	Maternal Labels	Maternal Declarations
Low Sensitivity Stage 2 Females	2.59**	3.17**
High Sensitivity Stage 2 Females	2.30*	2.52*
High Sensitivity Stage 3 Females	1.73	1.68
Low Sensitivity Stage 2 Males	0.00	<1.00
High Sensitivity Stage 2 Males	1.29	2.46*
Low Sensitivity Stage 3 Males	2.88**	3.04**
High Sensitivity Stage 3 Males	1.73	1.04

* $p < .05$
** $p < .01$

Discussion

Past research has provided very little information regarding the occurrence of different visual interactions between mothers and infants. Also, as noted earlier, such information has focused almost exclusively upon one such interaction-mutual gaze. Therefore, the occurrence of visual co-orientation, or attention to the same environmental feature, has been largely ignored. Further, even less is known regarding the types of communication behaviors which are emitted during peiods of mutual gaze and visual co-orientation.

The present study was intended to provide much-needed information regarding both of these issues. Additional purposes included the delineation of other parameters which might affect both visual interactions and communication resulting from these interactions. Chosen parameters consisted of infant sex, maternal sensitivity, and infant cognitive level.

In order to provide this information, the present study observed mothers and their 2-4 month-old infants in two different play situations, each of which was designed to enhance the occurrence of either mutual regard or visual co-orientation. Infants were evenly divided as to males and females, and also as to placement in Piaget's (1952) sensorimotor stages two or three; mothers were classified into high or low sensitivity groups. Measures were made of the occurrence of mutual gaze and visual co-orientation, as well as the communication behaviors occurring within these visual interaction episodes. Thus, the design of the present study allowed the examination of the ways in which infant sex and cognitive level and maternal sensitivity influences different visual interactions within mother-infant dyads and the communication which takes place within these interactions.

To briefly summarize the results of the present study, infant cognition by itself was found to significantly influence the average duration of mutual gaze episodes, with Stage 2 infants and their mothers engaging in relatively longer episodes. Also, infant cognition had singular impact upon maternal vocalizations during visual co-orientation sequences, as mothers used twice as many questions with their Stage 3 infants as with those infants in Stage 2. Finally, cognition tended to significantly affect visual co-orientation behaviors, with Stage 3 infants terminating more visual co-orientation episodes, and mothers of Stage 2 infants following their infants' gaze to objects more slowly. While no other main effects achieved significance, there was a tendency for sex to influence maternal vocalizations during mutual gaze, with mothers of females asking more questions than mothers of male infants.

The only two-way interaction to attain significance in the present analyses was that between infant sex and cognition with regard to maternal vocalizations during visual co-orientation episodes; this interaction revealed that, with increasing infant cognition, mothers utilized more declarations, questions, and labels with their daughters, but less of each of these verbalizations with their sons.

Other significant effects included an interaction between infant sex, maternal sensitivity, and cognitive level for both mutual gaze behaviors and maternal vocalizations during visual co-orientation. For mutual gaze behaviors, it was found that this interaction had significant impact upon the length of maternal and infant latency in following mutual gaze, as well as the number of times infants initiated and mothers terminated mutual gaze episodes. With regard to vocalizations during visual co-orientation, this interaction influenced the frequency with which mothers used labels and declarative sentences. Further, individual comparisons revealed that, for both interactions, the differences could largely be attributed to the behaviors of low sensitivity Stage 3 males and females and their mothers. Specifically, during mutual gaze, low sensitivity Stage 3 males demonstrated longer latencies in following maternal initiations, while they themselves initiated fewer mutual gaze sequences. Also, less sensitive mothers of Stage 3 females were slower in responding to their infants' initiations of mutual gaze, and also terminated more of these episodes than the less sensitive mothers of Stage 3 males. In considering vocalizations following visual co-orientation, mothers of low sensitivity Stage 3 females were found to use more labels and declaratives, particularly in comparison with mothers of low sensitivity Stage 3 males.

With regard to initiations and terminations of visual episodes, it was found that mothers were more likely to initiate mutual gaze and terminate visual co-orientation. Conversely, it was more probable that infants would initiate visual co-orientation and terminate mutual gaze.

Finally, this study revealed that mothers were more likely than infants to initiate communication sequences following the establishment of both mutual gaze and visual co-orientation.

Clearly, the most remarkable findings emerging from the present research involved the ways in which infant gender, maternal sensitivity, and infant cognitive level interacted to affect the measures utilized in this study. Especially intriguing was the consistency with which these interactions differentiated between low sensitivity Stage 3 females and low sensitivity Stage 3 males (while, in contrast, other groups were amazingly similar). The present discussion focuses upon the nature of these interactions, first with regard to visual behaviors, then as vocal exchanges were influenced.

When considering the mutual gaze behaviors observed in the present study, essentially the interaction between infant sex, cognition, and maternal sensitivity revealed the interactions of low sensitivity mothers and their male and female infants, by the third cognitive stage, to be grossly different. Specifically, a pattern emerged which depicted the male infants as relatively uninterested in mutual gaze with their mothers (as illustrated by their fewer initiations of mutual gaze and longer latencies in responding to mothers' looks), while, with female infants, mothers were the "reluctant" partners in mutual gaze episodes (as evidenced in their longer latencies in responding to their females' looks, as well as more terminations of mutual gaze).

Recent literature regarding mother-infant interaction has put forth the assumption that interaction patterns necessarily result from both maternal and infant behaviors (e.g., Goldberg, 1977). Certainly, the present findings support this assumption, as infant gender, infant cognitive level, and maternal sensitivity proved to be integral determinants of mutual gaze behaviors between mothers and their infants. As such, any attempt to explain the divergent patterns of these behaviors must focus upon the complex interplay of these three variables, especially within the context of mother-infant interaction. For instance, infant behaviors have been found to vary as a function of gender, with male infants having been described as more irritable (Moss, 1967) as well as more variable in their behaviors (Maccoby & Jacklin, 1974). Also, as Birns (1976) has noted, mothers have been observed to respond differentially to their male and female infants from their earliest interactions with them. Specific examples recently offered by Moss (1974) include more tactile stimulation to males, and more responsiveness to female infants' vocalizations. Birns (1976) has argued that such differential behaviors reflect different attitudes, acquired through socialization, toward male and female infants. Such an argument suggests that mothers bring into interactions with their infants preformed notions as to what male and female infants are like and how they behave. Given this information regarding the ways in which maternal attitudes and maternal/infant behaviors may be influenced by infant sex, it is hardly surprising that the present study revealed differences in mutual gaze episodes during mother-infant interactions.

However, while it may be postulated that the differential mutual gaze patterns observed in the present study were partially attributable to infant gender, it must also be kept in mind that such patterns did not emerge until the third sensorimotor stage. Also, such patterns were characteristic only of low maternal sensitivity mother-infant pairs. While a rationale for the fact that mutual gaze patterns differentiated between male and female infants only during the third sensorimotor stage is not readily apparent, related findings have been reported by previous researchers. For example, Moss and Robson (1968) have proposed that, with increases in time, visual interactions between mothers and their sons become less predictable than those of mothers and daughters. By way of explanation, these authors maintained that mothers experience more uncertainty concerning how they should behave toward boys; such relative uncertainty, for the most part, appears to derive from the male behaviors described above (e.g., irritability, variability). With regard to the present study's findings, it is not unreasonable to suggest that the very predictability (or lack of same) of the visual interactions have with their sons and daughters becomes an important consideration in those interactions. Specifically, it may be argued that by the third sensorimotor stage, a number of variables (e.g., maternal attitudes toward male and female infants, males' relatively more variable behaviors) have interacted such that mothers regard mutual gaze with their sons as a more challenging, and therefore, rewarding experience than do mothers of female infants; such an explanation may account for the more persistent maternal attempts to engage in mutual gaze observed between mothers and their sons in comparison with daughters. Further, the fact that such differential infant and maternal behaviors occurred only within low sensitivity mother-infant pairs has several implications. Most important, it would appear that the mutual gaze interactions of high sensitivity mother-infant pairs are relatively less influenced by the interaction of the factors described above. Specifically, it may be argued that high sensitivity mothers, from their first interactions with their infants, have less firmly established attitudes as to how male and female infants should be treated. In addition, while it is assumed that, at least initially, the male infants of high sensitivity mothers exhibited the same variable and/or irritable behaviors as those male infants of low sensitivity mothers (since such behaviors are thought to be at least part biologically determined), it may be suggested that high sensitivity mothers were better able to deal with those behaviors. In a sense, referring back to Moss and Robson's (1968) claims, it is possible that high sensitivity mothers do not experience as much "uncertainty" in their responses to their sons in comparison with low sensitivity mothers. As a result, differential patterns of mutual regard between mothers and their male and female infants may not be as likely to emerge.

To briefly summarize the complex interaction observed between infant sex, cognitive level, and maternal sensitivity as it influenced mutual gaze behaviors in the present study, it is clear that these factors operated in conjunction with each other, ultimately resulting in vastly different visual interaction patterns between mothers and infants during the third sensorimotor stage.

As it will be recalled, the factors of infant sex, cognitive level and maternal sensitivity also acted in conjunction with one another in influencing the occurrence of maternal vocalizations following the establishment of visual co-orientation. Again, vastly different patterns were found to characterize low sensitivity Stage 3 males and females and their mothers. Specifically, while with increasing cognitive level these mothers increased their vocalizations (particularly labels and declarations) to their female infants, less sensitive mothers actually were observed to decrease vocalizing to their sons.

As in the explanation of the three-way interaction effect on mutual gaze behaviors, clarifying the nature of the present interaction relies upon the complex interplay among infant cognition, maternal sensitivity, and infant gender, particularly within mother-infant interaction. Again, differential infant behaviors as a function of sex may be incorporated. For example, as Maccoby and Jacklin (1974) note, the sex difference literature often demonstrates female infants, as early as three months of age, to be more vocal than male infants, particularly when spontaneous vocalizations are considered. Differential maternal behaviors must also be considered, in that, overall, it appears that female infants receive more verbal stimulation from their caregivers (e.g., Lewis, 1972; Lewis & Freedle, 1972).

These types of findings indicate that, perhaps due to their female infants' relatively greater propensity to vocalize themselves, mothers find it more reinforcing to talk to their female infants in comparison with their sons. The greater amount of vocalizations to Stage 3 female infants during visual co-orientation by less sensitive mothers in the present study may similarly have reflected the relatively more rewarding verbal patterns which had been established in the present sample of mothers and daughters. This conclusion is somewhat qualified by the fact that mothers did not talk more to their female infants in comparison with their sons during mutual gaze. However, it should be noted that infant sex did approach significance in influencing maternal communication during mutual gaze, with mothers tending to question their daughters more than their sons.

Again, however, the fact that such an effect only emerged during the third sensorimotor stage, as well as only among low sensitivity mother-infant pairs must be taken into consideration. In addressing the first issue, it is not clear what specific mechanism underlies the emergence of this behavior at around this time; however, such findings are consistent with the sex difference literature. As Maccoby and Jacklin (1974) demonstrate, differences in the extent to which mothers verbalize to their male and female infants are not typically reported until around three months of age. Another possibility involves the unique presence of the toys during the visual co-orientation episode. It was sometimes observed that Stage 2 infants were not particularly interested in the toys, whereas such an observation was never made with Stage 3 infants; such an observation is consistent with Piaget's (1952) description of infant development, as he describes Stage 2 infants to be less than Stage 3 infants to exhibit interest in objects. Therefore, the finding that these particular mothers only increased vocalizations with their Stage

3 females may reflect the Stage 2 female infants' relative disinterest in the toys.

A final part of this discussion must address the fact that, as with mutual gaze behaviors, differential vocalizations to Stage 3 males and females only occurred among low sensitivity mother-infant pairs. Again, such a finding suggests that more sensitive mothers were not as influenced by preconceived notions regarding sex differences in infant behaviors (e.g., that female infants are more vocally interactive than male infants). In addition, these mothers did not vocalize significantly more with Stage 3 infants in comparison with Stage 2 infants. At first glance, such findings appear paradoxical, for the concept of maternal sensitivity is often characterized as the ability of mothers to respond to different infant cues (e.g., Ainsworth et al., 1974). In contrast, the present results indicate that high sensitivity mothers made no differential responses as a result of infant sex or cognitive level (as it will be recalled, the same was true for mutual gaze behaviors). However, it may be argued that, in communication (or visual) interaction with infants, infant gender and cognitive level are not the "appropriate" cues to respond to; rather, it is more likely that the infant's signals regarding the extent to which he/she is enjoying the communication sequence or visual interaction are the cues which will determine the more sensitive mothers' behaviors. As Ainsworth et al. (1974) suggest, maternal sensitivity may also be inferred from the degree to which mothers correctly read their infants' more subtle signals. Clearly, infant sex, and to a lesser extent, cognitive level, can hardly be considered subtle cues. However, the results of this study reveal that it was exactly these cues which determined the behaviors of the less sensitive mothers included in the present sample.

In briefly concluding the present discussion, again infant sex, cognitive level and maternal sensitivity were found to interplay in a complex fashion such that, for Stage 3 infants, the vocalization patterns between low sensitivity mothers and their male and female infants were found to be markedly discrepant.

As suggested previously, the major findings of the present research involved the consistent ways in which infant sex, cognitive level, and maternal sensitivity interacted to affect both visual and vocal behaviors. Particularly fascinating was the constant differentiation between low sensitivity Stage 3 males and females. If the results regarding mutual gaze and vocalizations following visual co-orientation are compared, it may be suggested that, while visual behaviors seem to characterize the interactions of less sensitive mothers and their Stage 3 sons (at least during mutual gaze episodes), vocal interactions are more typical of the interactions which occur between Stage 3 females and their low sensitivity mothers (at least during visual co-orientation episodes). While it is agreed that some assumptions are being made in the present argument, one cannot help but be impressed by these findings, particularly when one considers findings which are commonly acknowledged in the sex difference literature. Specifically, as mentioned previously, it is well known that females in comparison with males develop verbal skills more quickly. In contrast, many researchers have noted males' emergent superiority relative to females on spatial-visual tasks (e.g., Maccoby & Jacklin, 1974). Again, while it is admittedly speculative that precursors to these later sex differences were detected in the present research, these differential patterns for males and females are certainly intriguing.

In concluding the portion of the discussion which deals with the three-way interactions observed in the present study, these data suggest that, through the complex interplay of infant sex, cognitive level, and maternal sensitivity, vastly different patterns of both visual and vocal behaviors emerged. Clearly, some issues remain unclarified. For example, these three factors only interacted to significantly affect visual behaviors during mutual gaze, while visual co-orientation to objects was not influenced. Similarly, only vocalizations during visual co-orientation sequences varied as a function of this interaction, while mutual regard vocalizations did not. To a certain extent, such differences must be attributed to the contextual differences provided by the two experimental sessions. In addition, it is conceded that the proposed explanations for these interactions were largely speculative. Hopefully, future research may furthere clarify the complex ways in which these variables combine to influence mother-infant interaction measures, as well as the effects of situational context upon these combinations.

Additional issues which need to be addressed in the present section include a discussion of the experimental hypotheses which were offered at the outset of this study, specifically with regard as to their verification (or lack of same). First, it will be remembered that, of the three primary variables of interest in the present study, maternal sensitivity was expected to be the most important consideration in the occurrence of mutual gaze and visual co-orientation between these mother-infant pairs, as well as any accompanying communicative acts. Results failed to support this importance, as maternal sensitivity by itself did not influence any of the study's measures to a significant degree. Several explanations exist for this failure, the first of which is the most obvious: Simply, maternal sensitivity is not an important factor when examining the extent to which mothers and infants gaze at each other or to which mothers follow their infants' gaze. However, this explanation is so incongruent with previous research (e.g., Brazelton _et al._, 1974; Stern, 1971) which details the effects of maternal understimulation and/or overstimulation upon visual interactions, that alternative explanations should be considered.

One such explanations involves the suggestion that the low and high sensitivity groups formed in the present study were not as discrepant as would have been preferred. An examination of the distribution of scores yielded by the sensitivity scale which was utilized would support such a suggestion. For example, out of a possible 35 points, the range of forty scores fell within 21-35, with a median of 29. Therefore, mothers who were classifed as sensitive often had total scores which were only 2-3 points higher than those mothers who were classified as insensitive. Such a small range clearly could not allow an optimal discrimination of maternal sensitivity-insensitivity.

While it may be tempting to attribute this rather fine discrimination to an inadequacy in the sensitivity scale, it would appear that more likely at fault was the composition of the present maternal sample. Specifically, it can be argued that the current study consisted, for the most part, of mothers who had a high probability of being classified as sensitive; that is, it is often the case that, when subject selection relies upon telephone contact and agreement by the mother to allow experimenters into their homes, an exceptional sample (i.e., in terms of education, socioeconomic status, etc.) is likely to result. Such was the case in the present sample. Given these considerations, it is hardly surprising that maternal sensitivity did not prove to have the powerful impact it was expected to exert.

However, it must not be forgotten that maternal sensitivity did exert great influence upon the measures in the present study through its interaction with infant cognition and gender. Therefore, a second alternative explanation for the failure of maternal sensitivity to have its projected singular impact is based upon what may be referred to as experimenter naivete. Numerous developmentalists, notably Horowitz, Sullivan and Linn (1978) have emphasized the complex nature of infant development, particularly when interactional measures are being considered. To expect one characteristic of one partner to account for all behaviors produced in that partner's dyadic interaction with another is clearly incongruent with everything that is currently known in developmental psychology; clearly, the present research confirms the usefulness of an approach which predicts interaction effects.

In contrast to maternal sensitivity, experimental hypotheses regarding the effect of infant sex upon the present study's measures were upheld, as this variable failed to affect these measures by itself; as such, the present data support the findings of previous research (e.g., Brazelton et al., 1974). However, it will be remembered that a borderline effect of sex upon maternal vocalizations during mutual gaze was obtained, with mothers tending to vocalize more to their female infants; as such, then, the present research provides some support to literature which was previously discussed regarding relatively more vocalizations by caregivers to their female infants (e.g., Lewis, 1972; Lewis & Freedle, 1972).

Another set of hypotheses projected in the present study involved the influence of infant cognition. As shown in the results, none of these hypotheses were verified. First, it was expected that cognitive level would significantly influence the types of communication acts between mothers and infants, with higher cognitive level pairs being characterized by more complex (e.g., questions and sentences as opposed to gestures or monosyllabic utterances) communicative behaviors. Unfortunately, as described earlier, so few gestures and monosyllabic utterances were observed in the present sample that they could not even be subjected to analysis. Ling and Ling (1976) have also commented upon the infrequent occurrence of gestures even with very young infants. One factor which may have particularly contributed to the absence of gestures and monosyllabic usage in the present study was the conspicuous verbosity of this sample's mothers; undoubtedly, this characteristic relates to the problems of subject selection mentioned above.

Cognitive level did prove to have several unpredicted effects, however With regard to visual interaction behaviors, it was found that mothers and their Stage 2 infants averaged significantly more time per mutual gaze episode than mothers and their Stage 3 infants. While unexpected, this finding is quite consistent with the social learning literature, particularly the work of Kagan and his associates (e.g., Kagan, Henker, Hen-Tov & Lewis, 1966) regarding the construction by infants of facial schema. According to Kagan, once infants have firmly established a schema for the human face (an event which takes place approximately around four months of age), these faces become "too familiar," resulting in less attention to such faces. Therefore, the differences between Stage 2 and Stage 3 infants with regard to average length of each mutual gaze episode may have been due to the "excessive" familiarity of the mother's face.

In addition to this effect, cognitive level approached significance with regard to several visual co-orientation measures. Specifically, it appeared that: 1) Stage 3 infants terminated more visual co-orientation episodes than did Stage 2 infants; and that, 2) mothers of Stage 2 infants were slower to follow their infants' gaze to an object. Though not significant, these findings are interesting with regard to their implications for theoretical and research perspectives. For example, the finding that Stage 3 infants terminated more visual co-orientation episodes than did Stage 2 infants fits nicely into a Piagetian perspective. In his writings on the infant's construction of relations in space, Piaget (1953) discusses the infant's developing capacity to "compare" objects. For instance, when two objects were held side by side in front of an infant, Piaget observed that infants in the first and second sensorimotor stages would either: 1) look at one object only; or, 2) alternate their glances between the objects very slowly. However, Stage 3 infants performed very differently on this task, in that they were observed to quickly look from object to object, giving the appearance, as Piaget stated, of "comparing" the two. These observations are quite important to the present discussion, as it was very common to witness such a "comparison" procedure by Stage 3 infants in the present study during the toyboard session. For example, a frequent observation was the gazing of an infant to the car on the toyboard, subsequent visual co-orientation to the car by the mother, and the quick alternation by the infant to the pots and pans (which were beside the car). The mother would then gaze toward the pots and pans, only for visual co-orientation to be broken again by the infant, who had looked back at the car. In contrast, this pattern was never observed with the Stage 2 infants-they were much more likely to look at one toy for long periods of time than to look from toy to toy. Such observations are very congruent with Piaget's ideas on Stage 3 infants with regard to visual and spatial behaviors.

In contrast to these findings, an explanation for slower maternal visual co-orientation with Stage 2 infants is more difficult to explain. In the only other study on visual co-orientation which utilized different-aged infants, Collis and Schaffer (1975) reported no differences between the frequency with which mothers followed the gaze of their 19-27 and 45-53 week-old infants. However, the subjects employed by Collis and Schaffer were much older than those in the present study; also, Collis and Schaffer did not take latency measures. Comparisons between these two studies, then, are not particularly helpful. One possible explanation involves the extent to which Stage 2 mothers thought their infants were interested in toys. For example, it appeared that Stage 2 mothers were much more likely than Stage 3 mothers to inform the experimenter, upon presentation of the toyboard, that their babies were "just not interested in toys yet." Also, these mothers spent more time fixating upon their infants than upon the toyboard. Only when they perceived their infants to be gazing at the same toy for some length of time did they tend to look at the toy themselves. Such observations may be used to explain the relatively longer latency of Stage 2 mothers during visual co-orientation episodes.

A final singular effect of infant cognitive level was evidenced upon the maternal vocalizations which occurred during visual co-orientation episodes. However, it will be recalled that this effect was part of the three-way interaction discussed previously. Clearly, the impact of cognition in this analysis was greatest in conjunction with sex and sensitivity. Briefly, it was found that less sensitive mothers of females, with increasing infant cognition, increased their vocalizations to their infants while the less sensitive mothers of males decreased their vocalizations.

Final hypotheses which need to be be discussed involve the frequency with which mothers and infants initiated/terminated mutual gaze and visual co-orientation, as well as the more probable initiatior of communication sequences during visual interactions. As demonstrated by the conditional probability analyses, infants were responsible for the majority of initiations and terminations of mutual gaze; thus, the experimental hypotheses for these two events were confirmed. However, while it was expected that infants would also be responsible for visual co-orientation initiations and terminations, the results indicated the reverse. Specifically, mothers initiated and terminated the vast majority of these episodes, disproving the hypothese as to these behaviors. Finally, it was predicted that mothers would be more likely to initiate vocal exchanges following the establishment of both mutual regard and visual co-orientation. These hypotheses were confirmed, as mothers, for the most part, initiated all communication sequences to an overwhelming degree.

A discussion of the present study's results would not be complete without a brief examination of the information provided by the descriptive measures, most of which involved comparisons between visual co-orientation and mutual gaze. For example, it was revealed that these mother-infant pairs spent twice as much time in mutual gaze as in visual co-orientation. Such a finding is in contrast to Collis and Schaffer's (1975) claim that mothers and infants this young are much more likely to engage in joint attention to environmental features than to each other. No simple explanation appears to account for this conflict with previous literature. However, as noted initially, no other research has compared the occurrence of these two visual interactions among the same mother-infant pairs.

One of the more dramatic patterns revealed by these descriptive statistics was the finding that, while mothers were more interested in mutual gaze with their infants, infants preferred visual co-orientation periods. Further, such a pattern was observed along almost every dimension-for example, this pattern was reflected by the maternal initiation-infant termination sequence of mutual gaze which was most often observed. Also, the infant initiation-maternal termination sequency seen frequently in visual co-orientation episodes illustrates this pattern. Further, maternal and infant latencies in engaging in these visual interactions give a clue as to their preference for these interactions; specifically, infants were much quicker in following their mothers' gaze to an object than they were in joining eye-to-eye contact. Conversely, mothers instantly returned a mutual gaze initiation by their infant, but took a long time to follow their infants' gaze to a toy. While no other information exists regarding this issue, it appears that it may be possible to assess mother-infant reciprocity by determining the extent to which each partner appears willing to engage in his/her "nonpreferred" visual interaction. The most obvious example of this possibility was observed several times in the present study, particularly during mutual gaze episodes, when infants clearly did not want to look at their mothers. To the experimenter, a very adaptive behavior for the mothers would have entailed "switching" visual modes (i.e., from mutual gaze to visual co-orientation). While some mothers indeed switched modes, more mothers appeared unwilling to do so, often resulting in "forcing" their infants to look at them. For obvious reasons, the willingness of mothers to switch visual modes may eventually serve as a good index of maternal sensitivity.

The final descriptive measure to be discussed involves the relative efficiency with which mutual gaze and visual co-orientation may be said to facilitate communication between mothers and their infants. Clearly, the mutual gaze setting is more conducive to reciprocal vocal exchanges (as, in most cases, infants during the visual co-orientation session were sitting in their mothers' laps with their backs to them); such a conclusion is well-supported by the almost non-existence of infant vocalizations during visual co-orientation. Under such circumstances, it is not surprising that fewer maternal vocalizations also occurred during visual co-orientation. Overall, then, visual co-orientation would have to be considered less of a "setting event" for vocalization (e.g., Bloom, 1974) than mutual gaze episodes. However, it should not be concluded that visual co-orientation does not serve as a context for language development. As the present data showed, much labelling was found to occur during visual co-orientation, a finding which confirms, on a much larger scale, previous reports by Collis and Schaffer (1975). As such, the present study demonstrated that both mutual gaze and visual co-orientation are each rich "setting events" (although perhaps in different ways) for the acquisition of language.

A final issue to be discussed involves a basic, though perhaps implicit assumption of the present study which was proved to be absolutely incorrect. Specifically, at the outset of this research, it appeared as though mutual regard and visual co-orientation episodes were quite similar, and as such should show a great deal of relationship to each other. If anything conclusive resulted from this study, it was the convincing demonstration as to the utter independenc of these types of visual interactions. Further, almost every measure (e.g., maternal/infant initiations and terminations, latencies, vocalizations) confirmed this independence. However, this finding is by no means a negative finding-indeed, many possibilities arise as a result of this independence. For example, are some mother and infant pairs "mutual gazers" while others may be more accurately described as "visual co-orientors?" Observations made during the present study would certainly seem to support this notion. Further, given that this may be the case, what factors determine these differential types of visual interactions? These are just a few of the questions which need to be addressed by future research in further clarifying the different ways in which mothers and infants visually interact, as well as how these different visual interactions influence communication between a mother and her infant.

Conclusions and Implications

The present study was conducted primarily to document the occurrence of mutual gaze and visual co-orientation within the context of mother-infant interaction, with particular interest in the ways in which these two visual modes might be related to each other. In addition, the effects which infant cognition, infant sex and maternal sensitivity upon each of these types of visual interaction were of interest. On the basis of the obtained results, few of the experimental hypotheses offered at the outset of this research were confirmed. However, it may be argued that the results which were obtained are actually more significant with regard to development than confirmation of original hypotheses would have been. Specifically, the fact that maternal sensitivity, infant sex, and infant cognitive level interacted to result in the emergence of differential patterns for different mother-infant pairs is very intriguing, as well as being compatible with current conceptualizations of developmental processes.

The second major purpose of this research was to examine the ways in which mutual gaze and visual co-orientation sequences might serve to facilitate communication between mothers and infants, as well as the impact of infant sex, cognitive level and maternal sensitivity upon this communication. While no particularly strong conclusions may be drawn at the present from the obtained results, several interesting facts were revealed. First, mutual gaze is most likely a better facilitator of communication sequences in comparison with visual co-orientation, at least with infants this young. However, that is not to say that visual co-orientation does not enhance communication between mothers and infants-in fact, it may well be that visual co-orientation is an excellent way for infants to acquire names for objects, a finding quite in line with previous research. Overally, it appears that both of these visual interactions have substantial impact upon communication development, although each may operate in vastly different ways.

In terms of implications of the present research findings, it would seem as though future research needs to focus upon mother-infant samples in a relatively more extended age range than the one utilized in the present study. Further, a longitudinal examination of the issues of interest in the present research would appear to be essential-clearly, a one-time observation procedure as was utilized in the current study can only provide limitaed information regarding a seemingly complex process. Particularly of interest, if the founding assumptions of the present research are valid, would be an investigation of infants' language skills as a function of either mutual gaze or visual co-orientation.

Perhaps the most important piece of information revealed in this study involved the complex interactions which maternal sensitivity, infant cognitive level, and infant sex were observed to enter into. Such a finding, particularly in light of the consistency with which these interactions influenced visual and vocal behaviors, confirms the current view in developmental psychology regarding the complexities which are inherent in the examination of any developmental process. Future research in the area of visual and vocal interactions between mothers and their infants must necessarily include the variables utilized in this study, and perhaps more, if a complete picture of these processes is to be obtained. As the present study convincingly demonstrated, an emphasis on isolated factors when examining interactional processed will undoubtedly prove to be a fruitless endeavor.

References

Ainsworth, M. D. S. Attachment and dependency: A comparison. In J. L. Gewirtz (Ed.), Attachment and dependency. New York: John Wiley & Sons, 1972.

Ainsworth, M. D. S. The development of infant-mother attachment. In B. M. Caldwell & H. N. Ricciuti (Eds.), Review of child development research. Vol. III. Chicago: University of Chicago Press, 1973.

Ainsworth, M. D. S., Bell, S. M. & Stayton, D. J. Infant-mother attachment and social development: 'Socialisation' as a product of reciprocal responsiveness to signals. In M. P. M. Richards (Ed.), The integration of the child into a social world. London: Cambridge University Press, 1974.

Austin, J. L. How to do things with words. New York: Oxford University Press, 1962.

Bates, E., Benigni, L., Bretherton, I., Camaoni, L. & Volterra, V. From gesture to the first word: On cognitive and social prerequisites. In M. Lewis & L. A. Rosenblum (Eds.), Interaction, conversation and the development of language. New York: John Wiley & Sons, 1977.

Bates, E., Camaoni, L. & Volterra, V. The acquisition of performatives prior to speech. Merrill-Palmer Quarterly, 1975, 21(3), 205-226.

Bateson, M. C. Mother-infant exchanges: The epigensis of conversational interaction. Annals of the New York Academy of Sciences, 1975, 263, 101-113.

Birns, B. The emergence and socializations of sex differences in the earliest years. Merrill-Palmer Quarterly, 1976, 22, 229-254.

Bloom, K. Eye contact as a setting event for infant learning. Journal of experimental child psychology, 1974, 17, 250-263.

Bowlby, J. The nature of the child's tie to the mother. International journal of psychoanalysis, 1958, 39, 350-373.

Brazelton, T. B., Koslowski, B. & Main, M. The origins of reciprocity: The early mother-infant interaction. In M. Lewis & L. A. Rosenblum (Eds.), The effect of the infant on its caregiver. New York: John Wiley & Sons, 1974.

Brown, R. & Bellugi, U. Three processes in the child's acquisition of syntax. Harvard educational review, 1964, 34, 133-151.

Bruner, J. S. The ontongenesis of speech acts. Journal of child language, 1975, 2(1), 1-19.

Bruner, J. S. From communication to language-A psychological perspective. Cognition, 1976, 3(3), 255-287.

Bruner, J. S. Early social interaction and language acquisition. In H. R. Schaffer (Ed.), Studies in mother-infant interaction. London: Academic Press, 1977.

Chen, H. P. & Irwin, O. C. Infant speech vowel and consonant types. Journal of speech disorders, 1946, 11, 27-29.

Collis, G. M. Visual co-orientation and maternal speech. In H. R. Schaffer (Ed.), Studies in mother-infant interaction. London: Academic Press, 1977.

Collis, G. M. & Schaffer, H. R. Synchronization of visual attention in mother-infant pairs. Journal of child psychology and psychiatry, 1975, 16, 315-320.

Condon, W. S. & Sander, L. W. Synchrony demonstrated between movements of the neonate and adult speech. Child development, 1974, 45, 456-462.

Connell, D. B. Infant-mother interaction and early vocabulary development. Paper presented at the International Conference on Infant Studies, Providence, Rhode Island, March 1978.

Dale, P. S. Language development. Hinsdale, Illinois: The Dryden Press Inc., 1972.

DeMeis, D. K. The effects of maternal sensitivity, type of maternal cue, and infant cognitive stage on infants' preverbal communication development. Unpublished doctoral dissertation, West Virginia University, 1977.

Dollard, J. & Miller, N. E. Personality and psychotherapy. New York: McGraw-Hill Book Company, Inc., 1950.

Eimas, P. D., Siqueland, E. R., Jusczyk, P. & Vigorito, J. Speech perception in infants. Science, 1971, 171, 303-306.

Eisenberg, R., Griffin, E. J., Coursin, D. B. & Hunter, M. A. Auditory behavior in the human neonate: A preliminary report. Journal of speech and hearing research, 1964, 1(3), 245-269.

Etzel, B. C. & Gewirtz, J. L. Experimental modification of caretaker-maintained high-rate operant crying in a 6- and 20-week-old infant (Infans tyranno-teaurus): Extinction of crying with reinforcement of eye contact and smiling. Journal of experimental child psychology, 1967, 5, 303-317.

Fantz, R. L. The origin of form perception. Scientific American, 1961, 204(5), 66-72.

Fantz, R. L. Pattern vision in newborn infants. Science, 1963, 140, 296-297.

Fantz, R. L. Visual experience in infants: Decreased attention to familiar patterns relative to novel ones. Science, 1964, 146, 668-670.

Fodor, J. A., Garrett, M. F. & Brill, S. L. Pi ka pu: The perception of speech sounds by prelinguistic infants. Perception and psychophysics, 1975, 18, 74-78.

Fogel, A. Temporal organization in mother-infant face-to-face interaction. In H. R. Schaffer (Ed.), Studies in mother-infant interaction. London: Academic Press, 1977.

Fraiberg, S. Blind infants and their mothers: An examination of the sign system. In M. Lewis & L. A. Rosenblum (Eds.), The effect of the infant on its caregiver. New York: John Wiley & Sons, 1974.

Friedlander, B. Receptive language development in infancy. Merrill-Palmer Quarterly, 1970, 16, 7-51.

Gewirtz, J. L. Mechanisms of social learning: Some roles of stimulation and behavior in early human development. In D. A. Goslin (Ed.), Handbook of socialization theory and research. Chicago: Rand McNally, 1969.

Goldberg, S. Social competence in infancy: A model of parent-infant interaction. Merrill-Palmer Quarterly, 1977, 23, 163-177.

Goren, C. G., Sarty, M., & Wu, P. Y. K. Visual following and pattern discrimination of face-like stimuli by newborn infants. Pediatrics, 1975, 56, 544-549.

Haaf, R. A. & Bell, R. Q. A facial dimension in visual discrimination by human infants. Child development, 1967, 38, 893-899.

Horowitz, F. D., Sullivan, J. W. & Linn, P. Stability and instability in the newborn infant: The quest for elusive threads. In A. J. Sameroff (Ed.), Organization and stability of newborn behaviors: A commentary on the Brazelton Neonatal Assessment Scale. Monographs of the Society for Research in Child Development, 1978, 43 (Serial Number 177, 5-6).

Hutt, C. & Ounstead, C. The biological significance of gaze aversion with particular reference to the syndrome of infantile autism. Behavioral science, 1966, 11, 346-356.

Hutt, S. J., Hutt, C., Lenard, H. G., Bernuth, H. V. & Munthewerff, W. J. Auditory responsivity in the human neonate. Nature, 1968, 218, 88-90.

Irwin, O. C. Infant speech: Consonant sounds according to manner of articulation. Journal of speech disorders, 1947, 12, 402-404.

Irwin, O. C. Infant speech: Speech sound development of siblings and only infants. Journal of experimental psychology, 1948, 38, 600-602.

Irwin, O. C. & Chen, H. P. A reliability study of speech sounds observed in the crying of newborn infants. Child development, 1941, 12, 351-368.

Irwin, O. C. & Curry, T. Vowel elements in the crying vocalizations of infants under ten days of age. Child development, 1941, 12, 99-109.

Jenkins, J. The acquisition of language. In D. A. Goslin (Ed.), Handbook of socialization theory and research. Chicago: Rand-McNally, 1969.

Kagan, J., Henker, B. A., Hen-Tov, A. Levine, J. Lewis, M. Infants' differential reactions to familiar and distorted faces. Child development, 1966, 37, 519-532.

Karmel, B. Z. The effect of age, complexity, and amount of contour on pattern preferences in human infants. Journal of experimental child psychology, 1969, 7, 339-354.

Kaye, K. Toward the origins of dialogue. In H. R. Schaffer (Ed.), Studies in mother-infant interaction. London: Academic Press, 1977.

Kendon, A. Some functions of gaze-direction in social interaction. Acta psychologica, 1967, 26, 22-63.

Lewis, M. Infant speech. London: Routledge-Paul, 1936.

Lewis, M. State as an infant-environment interaction: An analysis of mother-infant behavior as a function of sex. Merrill-Palmer Quarterly, 1972, 18, 95-121.

Lewis, M. & Freedle, R. Mother-infant dyad: The cradle of meaning. In P. Pliner, L. Krames & T. Alloway (Eds.), Communication and affect: Language and thought. New York: Academic Press, 1973.

Ling, D. & Ling, A. H. Communication development in the first three years of life. Journal of speech and hearing research, 1974, 17, 146-159.

Luria, A. R. Speech development and the formation of mental processes. In M. Cole & I. Maltzman (Eds.), A handbook of contemporary Soviet psychology. New York: Basic Books, 1969.

Lynip, A. W. The use of magnetic devices in the collection and analysis of the preverbal utterances of an infant. Genetic psychology monographs, 1951, 44, 221-262.

Maccoby, E. E. & Jacklin, C. N. The psychology of sex differences. Stanford, California: Stanford University Press, 1974.

Macnamara, J. Cognitive basis of language learning in infants. Psychological review, 1972, 79, 1-13.

McGurk, H. Visual perception in young infants. In B. Foss (Ed.), New perspectives in child development. New York: Penguin Book Ltd., 1974.

McNeill, D. The development of language. In P. H. Mussen (Ed.), Carmichael's manual of child psychology. New York: John Wiley & Sons, 1970.

Miller, D. L., Morse, P. A. & Dorman, M. F. Cardiac indices of infant speech perception: Orienting and burst discriminations. Quarterly journal of experimental psychology, 1977, 29(3), 533-545.

Moerk, E. L. Piaget's research as applied to the explanation of language development. Merrill-Palmer Quarterly, 1975, 21, 151-169.

Moerk, E. L. Processes of language teaching and training in the interactions of mother-child dyads. Child development, 1976, 47, 1064-1078.

Moffitt, A. R. Consonant cue perception by twenty- to twenty-four-week-old infants. Child development, 1971, 42, 717-731.

Moss, H. A. Sex, age, and state as determinants of mother-infant interaction. Merrill-Palmer Quarterly, 1967, 13, 19-36.

Moss, H. A. Early sex differences and mother-infant interaction. In R. C. Friedman, R. M. Richards, & R. L. Vande Wiele (Eds.), Sex differences in behavior. New York: John Wiley & Sons, 1974.

Moss, H. A. & Robson, K. S. Maternal influences in early social visual behavior. Child development, 1968, 39, 401-408.

Piaget, J. Play, dreams, and imitation in childhood. New York: W. W. Norton & Company, 1951.

Piaget, J. The construction of reality in the child. New York: Basic Books, Inc., 1954.

Piaget, J. The origins of intelligence. New York: W. W. Norton & Company, 1952.

Piaget, J. The language and thought of the child. New York: New American Library, 1955.

Robson, K. S. The role of eye-to-eye contact in maternal-infant attachment. Journal of child psychology and psychiatry, 1967, 8, 13-25.

Ryan, J. Interpretation and imitation in early language development. In H. A. Hinde & J. Stevenson-Hinde (Eds.), Constraints on learning: Limitations and predispositions. London: Academic Press, 1973.

Ryan, J. Early language development: Towards a communicational analysis. In M. P. M. Richards (Ed.), The integration of the child into a social world. London: Cambridge University Press, 1974.

Salapatek, P. Pattern perception in early infancy. In L. B. Cohen & P. Salapatek (Eds.), Infant perception: From sensation to cognition, Volume 1: Basic visual processes. New York: Academic Press, 1975.

Scaife, M. & Bruner, J. S. The capacity for joint visual attention in the infant. Nature, 1975, 253(5489), 265-266.

Schaffer, H. R., Collis, G. M. & Parsons, G. Vocal interchange and visual regard in verbal and pre-verbal children. In H. R. Schaffer (Ed.), Studies in mother-infant interaction. London: Academic Press, 1977.

Sinclair, H. Sensorimotor action patterns as a condition for the acquisition of syntax. In R. Huxley & E. Engram (Eds.), Language acquisition: Models and methods. New York: Academic Press, 1971.

Stern, D. N. A micro-analysis of mother-infant interaction: Behavior regulating social contact between a mother and her 3½ month-old twins. Journal of the American Academy of Child Psychiatry, 1971, 10, 501-517.

Stern, D. N. Mother and infant at play: The dyadic interaction involving facial, vocal, and gaze behaviors. In M. Lewis & L. A. Rosenblum (Eds.), The effect of the infant on its caregiver. New York: John Wiley & Sons, 1974.

Trehub, S. E. Infants' sensitivity to vowel and tonal contrasts. Developmental psychology, 1973, 9, 91-96.

Trevarthen, C. Conversations with a two-month-old. New scientist, 1974, 230-235.

Trevarthen, C. Descriptive analyses of infant communicative behavior. In H. R. Schaffer (Ed.), Studies in mother-infant interaction. London: Academic Press, 1977.

Uzgiris, I. C. Patterns of vocal and gestural imitation in infants. In F. J. Monks, W. W. Hartup & J. DeWit (Eds.), Determinants of behavioral development. New York: Academic Press, 1972.

Uzgiris, I. C. & Hunt, J. M. Assessment in infancy: Ordinal scales of psychological development. Chicago: University of Chicago Press, 1975.

Vygotsky, L. S. Thought and language (E. Hanfmann & G. Vakar, eds. and trans.) Cambridge: MIT Press, 1962. (Originally published 1934).

Weir, R. Some questions on the child's learning of phonology. In F. Smith & G. A. Miller (Eds.), The genesis of language. Cambridge: MIT Press, 1966.

Whitehurst, G. J. & Vasta, R. Is language acquired through imitation? Journal of psycholinguistic research, 1975, 4, 37-59.

Winograd, T. Understanding natural language. Cognitive psychology, 1972, 3, 1-191.

Wolff, P. H. The natural history of crying and other vocalizations in early infancy. In B. M. Moss (Ed.), Determinants of infant behavior IV. London: Methuen, 1969.

Appendix A

Sensitivity Scale

For all items, let:

always equal 90-100% of the time
usually equal 65-90% of the time
sometimes equal 35-65% of the time
rarely equal 10-35% of the time
Never equal 0-10% of the time

1. Accessibility

    1. Mother never attends to infant (e.g., she spends her time looking around the infant lab, playing with infant's toys).
    2. Mother rarely attends to infant.
    3. Mother sometimes attends to infant.
    4. Mother usually attends to infant.
    5. Mother always attends to infant.

2. Threshold

    1. Mother usually responds to infant's signals of crying, laughing and crawling away.
    2. Mother usually responds to infant's signals of fussing and vocalizing (other than crying and laughing).
    3. Mother usually responds to infant's signals of smiling and grimacing.
    4. Mother usually responds to signals of gaze aversion and gaze-at behaviors.
    5. Mother usually responds to signals of stilling of body movements or increased body movements.

3. Freedom from distortion

    1. Mother always imposes her desires on infant.
    2. Mother usually imposes her desires on infant.
    3. Mother sometimes imposes her desires on infant.
    4. Mother rarely imposes her desires on infant.
    5. Mother never imposes her desires on infant.

    When scoring this item, disregard maternal responses which

Appendix A (con't)

failed to satisfy the infant's desires because they were inappropriate, e.g., the infant wanted to have a button so he could put it in his mouth.

The following are examples which can serve as guidelines in determining if the mother is imposing her own desires on her infant.

The mother restricts her infant's movements because it is inconvenient for her to move around.
The mother knows which toy her infant is asking for yet she hands him a toy which she seems to enjoy.

4. Over- and understimulation

1. Mother's responses usually result in infant's crying or active avoidance, i.e., crawling away, or negative vocalizations.
2. Mother's responses usually result in prolonged gaze aversion or agitated body movements.
3. Mother's responses sometimes result in infant's crying, active avoidance, negative vocalizations, prolonged gaze aversion and agitated body movements.
4. Mother's responses rarely result in infant's crying, active avoidance, negative vocalizations, prolonged gaze aversion and/or agitated body movements.
5. Mother's responses never result in infant's crying, active avoidance, negative vocalizations, prolonged gaze aversion, and/or agitated body movements.

5. Response is well-resolved

1. Mother's first or second response never results in infant's satisfaction.
2. Mother's first or second response rarely results in infant's satisfaction.
3. Mother's first or second response sometimes results in infant's satisfaction.
4. Mother's first or second response usually results in infant's satisfaction.
5. Mother's first or second response always results in infant's satisfaction.

To determine if mother's responses satisfied infant, use the following criteria:

Response terminated infant's crying, fussing, negative vocalizations, etc.
Response continued to elicit laughter, smiles, positive vocalizations.
Response reestablished eye contact.

Appendix A (con't)

6. Mother's promptness in responding

    1. Mother's response is never prompt.
    2. Mother's response is rarely prompt.
    3. Mother's response is sometimes prompt.
    4. Mother's response is usually prompt.
    5. Mother's response is always prompt.

    Promptness is judged by the time between the infant's signal and mother's response to the signal.

Appendix A (con't)

SENSITIVITY CODING SHEET

Subject #____________________

Date_________________________

Observer_____________________

1. Mother attends to infant:

   ____never ____rarely ____sometimes ____usually ____always

2. Mother usually responds to:

   ____crying, laughing and crawling away
   ____fussing and vocalizing (other than crying and laughing)
   ____smiling and grimacing
   ____gaze aversion and gaze-at behaviors
   ____stilling of body movements or increased body movements

3. Mother imposes her desires on infant:

   ____always
   ____usually
   ____sometimes
   ____rarely
   ____never

4. ____Mother's responses usually result in infant's crying or active avoidance, i.e., crawling away, or negative vocalizations.
   ____Mother's responses usually result in infant's crying, active avoidance, negative vocalizations, prolonged gaze aversion and agitated body movements.
   ____Mother's responses sometimes results in infant's crying, active avoidance, negative vocalizations, prolonged gaze aversion and agitated body movements.
   ____Mother's responses rarely result in infant's crying, active avoidance, negative vocalizations, prolonged gaze aversion and/or agitated body movements.
   ____Mother's responses never result in infant's crying, active avoidance, negative vocalizations, prolonged gaze aversion, and/or agitated body movements.

5. Mother's first or second response results in infant's satisfaction:
   ____never ____rarely ____sometimes ____usually ____always

6. Mother is prompt in responding:
   ____never ____rarely ____sometimes ____usually ____always

Appendix B

Coding Sheet

MG________ VC________
INITIATOR____ TIME________
FOLLOWER____ TIME________
TERMINATOR____ TIME________
Vocalizations/Gestures:
M:

I:

MG________ VC________
INITIATOR____ TIME________
FOLLOWER____ TIME________
TERMINATOR____ TIME________
Vocalizations/Gestures:
M:

I:

MG________ VC________
INITIATOR____ TIME________
FOLLOWER____ TIME________
TERMINATOR____ TIME________
Vocalizations/Gestures:
M:

I:

MG________ VC________
INITIATOR____ TIME________
FOLLOWER____ TIME________
TERMINATOR____ TIME________
Vocalizations/Gestures:
M:

I:

MG________ VC________
INITIATOR____ TIME________
FOLLOWER____ TIME________
TERMINATOR____ TIME________
Vocalizations/Gestures:
M:

I:

MG________ VC________
INITIATOR____ TIME________
FOLLOWER____ TIME________
TERMINATOR____ TIME________
Vocalizations/Gestures:
M:

I:

Appendix C

Raw Data

Sex	Sens	Cogn	Type Feed	Parity	MGN	MGT	MCAD	MGML	MGIL	MGTL	MGTI	MGMI	MGII	MGTT	MGMT
F	L	2	BR	M	12	118.05	9.84	1.27	4.36	3.74	10	08	02	12	11
F	L	2	BR	P	11	18.80	1.71	0.00	19.61	19.61	11	11	00	11	00
F	L	2	BR	P	36	152.45	4.23	2.38	4.07	3.22	36	33	02	35	03
F	L	2	BOT	P	17	139.51	11.41	1.06	7.85	7.31	16	14	02	16	04
F	L	2	BOT	P	09	268.72	29.86	.58	3.36	2.66	08	06	02	08	03
F	L	3	BOT	M	28	147.88	5.44	.98	3.85	3.04	22	14	07	27	12
F	L	3	BR	P	28	132.44	4.73	.43	4.50	4.90	22	19	03	25	06
F	L	3	BOT	M	38	159.16	4.19	1.12	3.72	2.33	28	13	15	38	26
F	L	3	BR	M	28	230.31	8.22	1.68	1.58	1.62	21	13	08	28	11
F	L	3	BR	P	16	69.59	4.64	.70	4.49	3.31	15	11	04	16	04
F	H	2	BOT	M	15	229.48	15.30	.46	3.25	1.97	13	07	05	13	07
F	H	2	BR	M	22	174.24	3.41	1.27	4.36	1.58	20	07	13	21	13
F	H	2	BR	P	21	162.28	7.73	.96	4.17	3.71	21	18	03	20	00
F	H	2	BR	M	36	220.88	6.14	1.73	3.22	2.40	31	14	17	34	18
F	H	2	BR	M	15	36.15	2.41	1.07	5.50	5.74	13	11	02	13	00
F	H	3	BOT	P	35	108.46	3.10	.72	4.48	4.18	25	23	02	33	12
F	H	3	BOT	M	03	1.12	.37	0.00	4.28	4.28	02	02	00	03	00
F	H	3	BR	P	61	188.81	3.10	1.04	1.37	1.58	50	40	10	57	14
F	H	3	BR	M	11	48.05	4.38	1.54	12.38	8.77	09	06	03	12	03
F	H	3	BOT	M	28	86.61	2.74	.82	5.63	4.70	22	20	04	26	07
M	L	2	BR	P	20	24.48	1.22	1.38	5.91	5.68	19	20	00	20	01
M	L	2	BR	M	26	255.91	9.84	.94	2.06	1.79	25	19	06	25	07
M	L	2	BOT	M	10	251.89	25.19	0.00	2.26	2.26	09	09	00	10	10
M	L	2	BR	M	22	205.86	9.36	1.33	5.88	3.60	18	09	09	21	10
M	L	2	BOT	P	13	129.31	9.95	1.75	2.16	2.00	13	08	05	12	06
M	L	3	BOT	M	20	68.20	3.41	0.00	9.55	9.55	18	18	00	17	00
M	L	3	BOT	M	07	13.77	1.97	0.00	10.49	10.49	07	07	00	07	01
M	L	3	BOT	M	05	17.85	3.57	0.00	41.86	41.86	04	04	00	06	00
M	L	3	BOT	P	07	19.01	2.72	0.00	21.90	21.90	06	06	00	06	00

Appendix C (con't)

Raw Data

Sex	Sens	Cogn	Type Feed	Parity	MGN	MGT	MGAD	MGML	MGIL	MGTL	MGTI	MGMI	MGII	MGTT	MGMT
M	L	3	BOT	P	09	29.71	2.92	0.00	20.95	20.95	09	09	00	09	00
M	H	2	BOT	M	11	32.40	2.94	1.07	4.68	4.32	10	09	01	11	00
M	H	2	BR	P	47	193.64	4.12	.80	1.15	1.06	47	35	12	37	13
M	H	2	BOT	P	14	238.98	17.07	.75	4.15	3.89	13	12	01	13	01
M	H	2	BR	P	24	242.19	10.09	.62	2.87	2.51	19	16	03	23	07
M	H	2	BOT	M	06	180.79	30.13	0.00	13.16	13.16	06	06	00	05	00
M	H	3	BOT	M	42	150.36	3.58	1.23	3.55	2.65	41	25	16	39	17
M	H	3	BOT	M	22	148.24	6.74	1.25	5.83	5.11	19	16	03	22	04
M	H	3	BOT	M	15	40.25	3.10	0.00	7.40	7.40	14	14	00	14	00
M	H	3	BOT	M	18	195.23	10.85	1.48	3.04	2.37	14	08	06	18	06
M	H	3	BR	P	25	85.33	3.41	1.08	5.94	4.20	14	09	05	25	14

KEY:

MGN-number of mutual gaze episodes

MGT-total time spent in mutual gaze

MGAD-average duration of each mutual gaze episode

MGML-average maternal latency in following infant initiation to mutual gaze

MGIL-average infant latency in following maternal initiation to mutual gaze

MGTL-average maternal and infant latency during mutual gaze

MGTI-total initiations of mutual gaze

MGMI-total maternal initiations of mutual gaze

MGII-total infant initiations of mutual gaze

MGTT-total number of terminations of mutual gaze

MGMT-total number of maternal terminations of mutual gaze

Appendix C

Raw Data

Sex	Sens	Cogn	MGIT	MGMVT	MGMVL	MGMVQ	MGMVD	MGIVT	MGIVP	MGIVN	VCN	VCT	VCAD	VCML	VCIL
F	L	2	1	07	0	01	06	01	00	01	27	33.84	1.25	4.69	2.26
F	L	2	11	06	0	04	02	03	00	03	20	14.38	.72	5.61	0.00
F	L	2	32	28	0	07	21	23	21	02	36	140.01	3.89	1.91	1.86
F	L	2	12	12	0	04	07	08	07	01	22	48.76	6.83	3.65	1.03
F	L	2	05	08	0	06	02	07	07	00	07	6.80	.97	2.38	0.00
F	L	3	15	23	0	07	14	08	08	02	38	127.03	2.76	1.97	1.20
F	L	3	19	22	2	08	12	08	07	01	36	162.00	4.50	2.02	1.32
F	L	3	12	32	0	11	21	22	16	06	34	77.47	2.28	1.85	1.99
F	L	3	17	24	0	09	15	09	09	00	36	41.13	1.14	2.18	0.00
F	L	3	12	13	0	03	10	03	02	01	45	139.42	3.10	1.83	1.50
F	H	2	06	12	0	06	06	04	04	00	23	24.02	1.04	4.91	0.00
F	H	2	08	18	0	11	07	11	00	00	30	37.80	1.26	3.06	1.09
F	H	2	20	16	0	04	12	05	05	00	21	40.67	1.94	3.92	.70
F	H	2	16	30	1	06	23	14	10	04	43	66.94	1.56	1.83	.88
F	H	2	13	03	0	01	02	02	02	00	17	21.04	1.24	3.18	1.50
F	H	3	21	26	0	08	18	05	05	00	39	112.44	2.88	1.80	1.62
F	H	3	03	00	0	00	00	00	00	00	62	66.39	1.07	2.39	.81
F	H	3	43	49	0	21	28	03	03	00	25	33.41	1.34	2.14	2.10
F	H	3	09	10	0	03	07	01	01	00	38	85.80	2.86	1.41	1.47
F	H	3	19	32	0	08	13	02	02	00	41	94.31	2.04	1.94	1.50
M	L	2	19	05	0	02	03	01	00	01	46	85.99	1.87	3.00	1.79
M	L	2	18	26	0	12	14	20	06	14	25	63.10	2.52	3.63	.40
M	L	2	00	08	2	04	04	00	00	00	23	136.08	5.92	1.43	4.41
M	L	2	11	18	0	09	09	12	11	01	36	82.20	2.28	2.48	1.70
M	L	2	06	12	0	02	10	06	06	00	34	80.54	2.37	4.01	1.70
M	L	3	17	09	0	01	08	12	09	03	29	32.77	1.13	1.05	.92
M	L	3	06	07	0	01	06	03	03	00	23	36.16	1.57	3.17	1.33
M	L	3	06	03	0	01	02	01	01	00	17	36.92	2.17	2.30	1.30
M	L	3	06	03	0	01	02	00	00	00	50	148.80	2.98	2.44	4.48
M	L	3	08	06	0	01	04	03	04	00	30	63.66	1.96	2.24	2.01

Appendix C (con't)

Raw Data

Sex	Sens	Cogn	MGIT	MGMVT	MGMVL	MGMVQ	MGMVD	MGIVT	MGIVP	MGIVN	VCN	VCT	VCAD	VCML	VCIL
M	H	2	11	09	1	01	07	01	00	01	09	11.76	1.31	8.32	0.00
M	H	2	24	19	0	02	17	16	12	04	69	206.96	3.00	1.81	.76
M	H	2	12	10	0	02	08	07	06	01	33	97.78	2.96	4.01	1.38
M	H	2	16	16	0	05	11	10	08	02	29	76.78	2.65	3.15	1.55
M	H	2	05	06	0	02	04	04	04	00	28	51.68	1.84	2.69	2.00
M	H	3	22	25	0	05	20	07	05	02	37	104.63	2.83	2.79	1.56
M	H	3	18	18	0	01	17	13	11	02	34	106.55	3.13	2.94	2.36
M	H	3	14	10	0	04	06	08	06	02	54	73.82	1.37	1.73	2.41
M	H	3	12	15	0	05	10	03	03	00	14	31.32	2.24	2.22	2.23
M	H	3	11	14	0	02	12	06	06	00	32	76.18	2.38	2.21	1.58

KEY:

MGIT-total number of infant terminations of mutual gaze

MGMVT-total number of maternal vocalizations during mutual gaze

MGMVL-number of maternal labels during mutual gaze

MGMVQ-number of maternal questions during mutual gaze

MGMVD-number of maternal declarations during mutual gaze

MGIVT-total number of infant vocalizations during mutual gaze

MGIVP-number of positive infant vocalizations during mutual gaze

MGIVN-number of negative infant vocalizations during mutual gaze

VCN-number of visual co-orientation episodes

VCT-total time spent in visual co-orientation

VCAD-average duration of each visual co-orientation episode

VCML-average maternal latency during visual co-orientation

VCIL-average infant latency during visual co-orientation

Appendix C

Raw Data

Sex	Sens	Cogn	VCTL	VCTI	VCMI	VCII	VCTT	VCMT	VCIT	VCMVT	VCMVL	VCMVQ	VCMVD	VCIVT	VCIVP	VCIVN
F	L	2	4.44	26	02	24	25	21	04	11	2	06	03	00	00	00
F	L	2	5.61	20	00	20	21	20	01	12	1	02	09	00	00	00
F	L	2	1.88	35	16	17	27	10	17	06	1	03	02	00	00	00
F	L	2	3.58	22	04	17	20	14	05	08	1	03	03	00	00	00
F	L	2	2.38	06	00	06	07	07	00	03	0	03	00	00	00	00
F	L	3	1.87	36	10	26	37	22	15	26	5	08	13	04	04	00
F	L	3	1.73	34	14	20	36	14	22	22	5	08	09	25	14	01
F	L	3	1.91	32	14	18	32	16	16	33	3	09	21	02	02	00
F	L	3	2.18	36	00	36	35	34	01	21	6	04	11	00	00	00
F	L	3	1.66	43	13	30	44	23	21	28	4	12	12	00	00	00
F	H	2	4.91	23	00	23	24	24	00	06	0	04	02	00	00	00
F	H	2	2.79	29	04	25	28	18	10	03	0	01	02	02	00	02
F	H	2	3.76	21	20	01	21	18	03	13	2	06	05	01	00	01
F	H	2	1.79	43	02	41	44	33	11	28	5	06	17	00	00	00
F	H	2	2.94	17	02	15	18	16	02	02	0	01	01	00	00	00
F	H	3	1.78	38	03	35	38	29	09	13	0	04	09	06	05	01
F	H	3	2.31	60	03	57	60	56	04	46	1	25	20	05	01	04
F	H	3	2.13	24	02	22	22	20	02	17	4	11	02	01	01	00
F	H	3	1.42	36	09	27	36	23	13	22	4	17	01	01	01	00
F	H	3	1.91	40	04	35	39	32	07	24	2	14	08	03	02	01
M	L	2	2.89	44	40	04	45	40	05	24	2	07	15	06	04	02
M	L	2	3.49	24	01	23	24	22	02	18	4	05	09	05	01	04
M	L	2	2.85	23	11	12	21	11	10	17	6	05	06	01	01	00
M	L	2	2.36	33	05	28	36	30	06	24	8	04	12	04	03	01
M	L	2	3.94	32	01	31	31	30	01	10	3	04	12	00	00	00
M	L	3	1.03	27	04	23	28	18	10	03	0	01	02	02	00	02
M	L	3	2.92	22	03	19	22	20	02	08	2	02	04	00	00	00
M	L	3	2.18	17	02	15	17	15	02	05	0	04	01	00	00	00
M	L	3	2.52	47	02	45	48	42	06	22	0	13	09	18	18	00

Appendix C (con't)

Raw Data

Sex	Sens	Cogn	VCTL	VCTI	VCMI	VCII	VCTT	VCMT	VCIT	VCMVT	VCMVL	VCMVQ	VCMVD	VCIVT	VCIVP	VCIVN
M	L	3	2.15	28	03	26	29	24	05	07	1	04	03	05	05	00
M	H	2	8.32	09	00	09	14	13	01	05	1	04	00	00	00	00
M	H	2	1.70	69	07	62	59	62	07	09	1	04	04	03	00	03
M	H	2	3.75	31	03	28	31	30	01	25	8	06	11	05	04	01
M	H	2	3.09	26	01	25	29	27	02	11	2	04	05	03	02	01
M	H	2	2.64	27	02	25	27	26	01	16	2	06	08	00	00	00
M	H	3	2.57	34	06	28	35	26	09	16	1	06	09	01	01	00
M	H	3	2.84	31	05	26	31	26	05	16	1	02	12	01	01	00
M	H	3	1.93	51	15	36	49	34	15	19	0	06	13	11	01	10
M	H	3	2.22	13	03	10	14	11	03	07	1	01	03	02	01	01
M	H	3	2.17	30	02	28	33	24	09	30	8	09	13	01	00	00

KEY:

VCTL-average latency during visual co-orientation

VCTI-total initiations of visual co-orientation

VCMI-total maternal initiations of visual co-orientation

VCII-total infant initiations of visual co-orientation

VCTT-total terminations of visual co-orientation

VCMT-total maternal terminations of visual co-orientation

VCIT-total infant terminations of visual co-orientation

VCMVT-total maternal vocalizations during visual co-orientation

VCMVL-total maternal labels during visual co-orientation

VCMVQ-total maternal questions during visual co-orientation

VCMVD-total maternal declarations during visual co-orientation

VCIVT-total infant vocalizations during visual co-orientation

VCIVP-positive infant vocalizations during visual co-orientation

VCIVN-negative infant vocalizations during visual co-orientation

Appendix D

Conditional Probabilities-Maternal/Infant Initiations
and Terminations of Visual Co-Orientation
By Sex, Sensitivity and Cognitive Level

	Maternal Initiations	Infant Initiations	Maternal Terminations	Infant Terminations
Stage 2				
Females				
Low Sensitivity	.20	.77	.68	.21
High Sensitivity	.07	.91	.90	.09
Males				
Low Sensitivity	.12	.82	.43	.15
High Sensitivity	.07	.89	.92	.14
Stage 3				
Females				
Low Sensitivity	.28	.69	.59	.39
High Sensitivity	.08	.87	.74	.23
Males				
Low Sensitivity	.11	.83	.79	.24
High Sensitivity	.19	.72	.70	.25

Appendix D

Conditional Probabilities-Maternal/Infant Initiations and Terminations of Mutual Gaze By Sex, Sensitivity and Cognitive Level

	Maternal Initiations	Infant Initiations	Maternal Terminations	Infant Terminations
Stage 2				
Females				
Low Sensitivity	.62	.10	.15	.62
High Sensitivity	.59	.31	.50	.46
Males				
Low Sensitivity	.70	.15	.31	.57
High Sensitivity	.79	.18	.30	.69
Stage 3				
Females				
Low Sensitivity	.53	.29	.45	.60
High Sensitivity	.73	.10	.23	.73
Males				
Low Sensitivity	.87	.04	.04	.91
High Sensitivity	.41	.24	.37	.62

Appendix E

Conditional Probabilities-Maternal/Infant
Initiations of Communication
During Visual Episodes

	Maternal Initiations	Infant Initiations	Maternal Terminations	Infant Terminations
Stage 2				
Females				
Low Sensitivity	.54	.24	.32	0.0
High Sensitivity	.77	.06	.52	.01
Males				
Low Sensitivity	.77	.02	.63	.04
High Sensitivity	.62	.11	.43	.06
Stage 3				
Females				
Low Sensitivity	.82	.08	.71	.02
High Sensitivity	.80	.06	.56	.04
Males				
Low Sensitivity	.62	.09	.33	.09
High Sensitivity	.60	.04	.48	.06

Appendix F

Visual Co-Orientation Measures-Means and Standard Deviations
By Sex, Sensitivity and Cognitive Level

	Average Duration		Maternal Latency		Infant Latency	
	Mean	SD	Mean	SD	Mean	SD
Stage 2	2.37	1.60	3.48	1.59	1.25	1.04
Females	2.07	1.90	3.51	1.29	.93	.79
Low Sensitivity	2.73	2.62	3.65	1.55	1.03	1.04
High Sensitivity	1.41	.35	3.38	1.14	.83	.55
Males	2.67	1.26	3.45	1.91	1.57	1.20
Low Sensitivity	2.99	1.65	2.91	1.01	2.00	1.46
High Sensitivity	2.35	.75	4.00	2.54	1.14	.78
Stage 3	2.29	.87	2.13	.49	1.68	.87
Females	2.40	1.06	1.95	.26	1.35	.60
Low Sensitivity	2.76	1.22	1.97	.14	1.20	.74
High Sensitivity	2.04	.84	1.94	.37	1.50	.46
Males	2.18	.68	2.31	.61	2.02	.99
Low Sensitivity	1.96	.69	2.24	.76	2.01	1.44
High Sensitivity	2.29	.67	2.37	.49	2.03	.42

Appendix F

Visual Co-Orientation Measures-Means and Standard Deviations
By Sex, Sensitivity and Cognitive Level

	Maternal Initiations		Infant Initiations		Maternal Terminations		Infant Terminations	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Stage 2	6.05	9.68	21.80	13.65	23.60	12.44	4.45	4.54
Females	5.00	7.07	18.90	10.95	18.10	7.29	5.30	5.62
Low Sensitivity	4.40	6.69	16.80	6.68	14.40	6.11	5.40	6.80
High Sensitivity	5.60	8.17	21.00	14.63	21.80	6.94	5.20	4.97
Males	7.10	12.05	24.70	15.96	29.10	14.36	3.60	3.20
Low Sensitivity	11.60	16.40	19.60	11.32	26.60	10.81	4.80	3.56
High Sensitivity	2.60	2.70	29.80	19.48	31.60	18.20	2.40	2.61
Stage 3	10.80	23.58	28.10	10.69	25.45	10.49	8.80	6.35
Females	17.10	32.72	30.60	11.28	26.90	12.09	11.00	7.57
Low Sensitivity	30.00	44.56	26.00	7.35	21.80	7.82	15.00	8.40
High Sensitivity	4.20	2.77	35.20	13.38	32.00	14.23	7.00	4.30
Males	4.50	3.92	25.60	10.01	24.00	9.03	6.06	4.14
Low Sensitivity	2.80	.84	25.60	11.61	23.80	10.69	5.00	3.32
High Sensitivity	6.20	5.17	25.60	9.53	24.20	8.32	8.20	4.60

Appendix G

Vocalizations During Mutual Gaze-Means and Standard Deviations
By Sex, Sensitivity and Cognitive Level

	Maternal Questions		Maternal Declarations		Total Infant Vocalizations	
	Mean	SD	Mean	SD	Mean	SD
Stage 2	4.55	3.25	8.75	6.09	7.75	6.55
Females	5.00	2.94	8.80	7.61	7.80	6.71
Low Sensitivity	4.40	2.30	7.60	7.83	8.40	8.65
High Sensitivity	5.60	3.65	20.00	3.65	7.20	5.07
Males	4.10	3.63	8.70	4.73	7.70	6.75
Low Sensitivity	5.80	4.49	8.00	4.53	7.80	8.32
High Sensitivity	2.40	1.52	9.40	4.93	7.60	5.77
Stage 3	5.00	5.01	11.25	7.23	5.85	5.36
Females	7.80	5.71	13.80	7.66	6.10	6.40
Low Sensitivity	7.60	2.97	14.40	4.16	10.00	7.11
High Sensitivity	8.00	8.03	13.20	10.66	2.20	1.92
Males	2.20	1.75	8.70	4.09	5.60	4.43
Low Sensitivity	1.00	0.00	4.40	2.61	3.80	4.76
High Sensitivity	3.40	1.82	13.00	5.57	7.40	3.65