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Infant social referencing and exploratory confidence related to maternal support for autonomy

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INFANT SOCIAL REFERENCING AND EXPLORATORY CONFIDENCE RELATED TO MATERNAL SUPPORT FOR AUTONOMY

by

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Abstract

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EMILY GUILE

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This laboratory study explored the possibility that infant differences in social referencing (frequency of referencing mother's positive facial expression and babies' exploratory confidence in response to an unfamiliar, potentially anxiety-provoking stimulus) are related to maternal encouragement of infant autonomy. The study videotaped twenty-six mothers and their 11- to 14-month-old infants in situations designed to assess (1) infant differences in social referencing and (2) maternal differences in autonomy-promoting play style. In addition, the researcher tested infants on a series of cognitive (object permanence) tasks and mothers rated their babies on the Approach and Activity Level subscales of the Toddler Temperament Scale (TTS) (Fullard, McDevitt & Carey, 1978).

Analysis of the data confirmed the hypothesis that maternal support for infant autonomy is linked with both

referencing frequency and likelihood of approaching an unfamiliar, potentially anxiety-provoking stimulus among one-year-olds. Mothers who let baby initiate, lead and control play, who adapted to baby's pace and goals and who reinforced baby's pleasure in discovery during free play, tended to have infants who referenced infrequently and who approached the unfamiliar stimulus. In contrast, babies of mothers who tried to control infant play, who interrupted and interfered with baby's ongoing activity and who demonstrated toy play without baby's active participation referenced mother at a significantly higher rate and avoided contact with the unfamiliar stimulus. Babies' social referencing and approach/avoidance behavior was stable across two separate episodes designed to elicit these behaviors. Maternal perceptions of infants' typical Approach behavior on the TTS also predicted these infant differences; babies who referenced mother at a lower rate and who approached the unfamiliar stimulus received significantly higher maternal ratings on acceptance of and approach to unfamiliar events during daily life. Neither infant Activity Level nor object concept development (object permanence) predicted infant differences in referencing and exploratory confidence.

Study findings are considered in the context of other research linking specific maternal behaviors with infant socio-emotional variables. Implications for the development of the self during infancy are also discussed.

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To Alison and Cynthia ... who were its original, although until recently unrecognized, inspiration,

To Judy ... for helping in countless ways to realize the inspiration, and

To Steve ... for staying the distance and so much more.

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CHAPTER I

Introduction

Personality development during infancy is an increasingly popular research area. The impact on early personality of variables such as mother-infant attachment and temperament have been studied in detail. The study described below represents the second phase of a research project focusing on a central feature of early socio-emotional development: How babies rely on their primary attachment figures to explore and learn about the world. The study examined the one-year old infant's use of maternal emotional (facial) cues for guidance in new situations. This mode of communication is referred to in the literatures as "social" or "maternal" referencing, and is defined as:

> "the tendency of a person of any age to seek out emotional information from a significant other person in the environment and to use that information to make sense of an event that is otherwise ambiguous or beyond the person's own intrinsic appraisal capabilities ... the behavior of the referencing individual is predicted to differ as a function of [this] emotional information" (Klinnert, Campos, Sorce, Emde & Svejda, 1983).

Babies are likely to engage in maternal referencing when they experience uncertainty, that is, conflicting approach and avoidance responses to the same stimulus (Gunnar and Stone, 1984). Uncertainty may prompt baby to

look to mother in order to discern from her emotional response whether a new stimulus can be trusted.

Infants begin to reference at about 10 months of age (Sorce, Emde & Frank, 1982). They may look from an unfamiliar object or person to mother's face several times, appearing to determine from her emotional response whether it is safe to approach the stimulus. Although specific cognitive advances must occur before infants understand the emotional meanings communicated by discrete facial expressions, social referencing is usually discussed as an aspect of emotional development. It is thought that infants are motivated primarily by the need to resolve affective uncertainty when they look to mother.

Social referencing research with infants began in the late 1970s. Typical experiments confront baby with a stimulus intended to arouse uncertainty (the visual cliff, remote-controlled toys which appear unexpectedly), while mother simultaneously communicates a positive or negative emotion by posing highly exaggerated facial expressions of joy or fear. Sorce, Emde, Campos & Klinnert (1985) observed infants separated from their mothers by a visual cliff modified to elicit hesitation but not complete avoidance of crossing. Most infants whose mothers smiled crossed the deep side of the cliff to reach her. In contrast, very few infants whose mothers posed a fearful expression crossed the cliff. Other referencing experiments observe infant

behavior toward unfamiliar objects and people in response to positive versus negative maternal emotions.

With few exceptions, infant social referencing is discussed in the literature as a relatively simple process of maternal influence on infant appraisal of novel stimuli. However, a review of studies conducted to date reveals that maternal emotions do not consistently predict babies' responses to unfamiliar stimuli. In fact, with the exception of the visual cliff study described above, main effects for maternal expressions are small or nonexistent (Hirshberg & Svejda, 1990). This suggests that factors other than mother's facial expression are important in determining how babies behave in uncertain situations.

In a study designed to identify and describe infant differences in maternal referencing and subsequent behavior toward a novel, uncertainty-producing stimulus (Guile, 1987) babies and mothers participated in a 2 1/2 minute experimental situation in which a remote-controlled toy robot confronted baby; mother posed a happy facial expression. The robot appeared without warning in the experimental room and moved in a random pattern for 30 seconds before stopping at a point equidistant from mother and infant. For the first 90 seconds of the trial, mother posed the happy expression; for the remainder she posed a neutral expression.

Videotapes of the above situation provide clear evidence that individual differences in maternal referencing are substantial among normal infants. The one-year-olds responded very differently toward the robot, even though mothers displayed the same emotional expression. Babies exhibited four distinct patterns of behavior:

1. As soon as baby became aware of robot, she/he eagerly approached and explored it without first referencing mother (8 out of 19 babies).
2. Baby referenced mother after becoming aware of the robot's entrance into the room and, apparently encouraged by her positive expression, approached and explored robot (7/19 babies).
3. Baby referenced mother but continued to appear distressed over the robot's presence in the room despite mother's reassuring expression. Baby then approached mother instead of robot (3/19 babies).
4. In one case, baby appeared alarmed by robot but neither referenced mother nor approached her for comfort.

To summarize the results cited above, fewer than half of the babies tested in the author's 1987 study exhibited the behavioral sequence (e.g., seeking out the mother's positive reaction and approaching the novel stimulus) comprising the full definition of maternal referencing. Although only half (58%) of the babies turned to look at

mother after the robot entered the room, most (79%) initially approached the robot instead of mother. In addition, infants differed greatly with respect to referencing frequency, robot approach latency, time spent exploring the robot, etc. The most interesting findings were (1) that referencers and non-referencers of mother's positive expression were equally likely to approach the robot and (2) that non-referencers tended to approach the robot more quickly than referencers. It appeared that non-referencers concluded on their own that the robot was not a threat and therefore did not need to engage in a "secondary appraisal process" (Klinnert, et al., 1983). For these babies, novelty aroused the urge to explore, rather than wariness or the need for maternal reassurance (Bowlby, 1969). For other infants, the reverse was true: They avoided the stimulus even after observing mother's positive reaction.

Results from the pilot research and other studies suggest that the infant social referencing paradigm needs to be modified to account for individual differences. It is clearly not the case that all infants respond in an identical manner even when an experimental situation exposes them to a single stimulus and a single maternal emotion. The current paradigm embodies an outmoded view of infants as passive recipients of parental influence rather the more recent concept of babies as active contributors to parent-

infant interactions. Because of this bias, it cannot account for the two major departures from social referencing theory identified in the pilot research -- babies who eagerly approached the robot without referencing mother, and those who referenced mother, perhaps numerous times, but were unable to approach and explore the robot. The study discussed below explored the central issue raised by the pilot research -- how to account for the striking infant differences in social referencing described. An important departure from previous research was the inclusion of babies who did not reference in the final data analysis.

Characteristics of Infant Social Referencing Research

Emphasis on facial affects. Most referencing experiments investigate the impact of mothers' facial expressions on infant behavior. Mothers are trained to pose "peak" affective expressions both to control for maternal differences in expressivity and to maximize effects on infant behavior. This focus on facial communication of affect reflects the traditional research focus on emotions conveyed by the human face (Izard, 1977). Cross-cultural studies provide evidence that specific facial expressions universally communicate the same emotions (Ekman & Friesen, 1975). They also document "a species-wide, intuitive capacity" to express these emotions under similar circumstances (Sorce, et al., 1985). Facial affects can be reliably and validly measured by analyzing the discrete

muscular movements which combine to form different expressions (Ekman, Friesen & Ellsworth, 1972).

Facial displays of emotion and parent-infant communication.

Studies of mother-infant dyads provide evidence that

> "facial expressions of emotion are not merely responses indicative of internal states ... [but] also stimulus patterns that regulate the behavior of others" (Sorce, et al., 1985; my emphasis).

The recognition that maternal referencing plays a role in early development prompted infancy researchers to explore the role of facially-conveyed emotions in parent-child communication, a phenomenon already identified by observers of nonhuman primates (Goodall, 1986). Social referencing is compatible with current views of infant socioemotional development in which the exchange of emotional signals serves as the primary mode of parent-infant preverbal communication (Brazelton & Cramer, 1990). Before language is available, this preverbal exchange enables parents to provide the infant with "salient information about events and interactions" and the infant to influence the behavior of its caretakers (Hornik, Risenhoover & Gunnar, 1987; Nelson, 1987).

Infant referencing behavior reflects the unique emotional bond between baby and primary caretaker. When mother is absent, baby may attend to information provided by a stranger about an unfamiliar stimulus but seldom uses this information to guide behavior. Zarbatany & Lamb (1985) placed half of their infant subjects with a "familiarized

stranger" and half with mother in an experimental room. When a remote-controlled toy spider entered the room, babies were equally likely to reference stranger and mother, but only mother's positive expression encouraged them to approach the spider. In contrast, when mother is present and neutral some babies will use emotional signals provided by a friendly adult (Klinnert, et al., 1986).

The finding that maternal emotions influence infant behavior toward novel stimuli suggests that referencing mediates vicarious learning during infancy, when babies encounter a "perpetual stream of novel or otherwise ambiguous events" (Walden & Ogan, 1988). Campos and Stenberg (1981) point out that "an infant capable of maternal referencing is no longer tied to first-hand experiencing of positive or negative consequences for each unfamiliar stimulus". However, although the adaptive value to the infant of being able to learn about the world by relying on maternal signals is obvious, it is not yet known whether the influence of maternal referencing on infant appraisals of novel stimuli persists over time. Very short-term effects of one to three minutes were reported by Feinman & Lewis (1983). Hornik, et al. (1987) demonstrated that 12-month-old infants initially exposed to negative or positive messages about toys continued to behave differently toward the toys when mothers remained silent and neutral during a second trial eight minutes later. They concluded

that maternal referencing serves as more than an immediate guide to behavior but "how long the effects of the mother's affective reaction last, and the influence of different intervening events, remains to be determined".

Mothers versus fathers as referencing targets. Infant referencing research focuses almost exclusively on the mother-infant dyad. Although the present research continues this tradition, recent studies indicate that babies are equally likely to solicit emotional information from fathers in uncertain situations (Dickstein & Parke, 1988) and to use this information to regulate their behavior (Hirshberg & Svejda, 1990). In fact, when parents provide their one-year-olds with conflicting emotional signals, babies do not choose between parental cues but exhibit distress over being placed in conflict (Hirshberg, 1990).

Parameters of Infant Social Referencing

Cognitive uncertainty. Babies are most likely to reference and make use of maternal information when they experience a situation as ambiguous or uncertain. Upon encountering a new object or person, an infant "calls on 'intrinsic appraisal processes' to evaluate the likelihood of pleasant or unpleasant consequences" ensuing from stimulus contact (Sorce, Emde & Frank, 1982). If these intrinsic or primary appraisal processes allow the infant to conclude on its own that the stimulus can be approached or should be avoided, the mother's assistance in evaluating the

stimulus will not be needed. For example, infants are unlikely to reference before crossing a visual cliff adjusted to minimize depth cues. If they do reference, babies whose mothers pose a fearful expression cross anyway (Sorce, et al., 1985). In another experiment, Gunnar & Stone (1984) presented infants with both ambiguous and unambiguous toys (e.g., toys which elicit clear approach or withdrawal). Mothers' posed expressions of affect were found to influence babies' behavior only toward the ambiguous toys. In contrast, when primary appraisal processes do not allow the infant to make such an evaluation, the infant seeks out emotional cues from an attachment figure to resolve its uncertainty. Maternal referencing can therefore be conceptualized as contributing to a "secondary appraisal process" (Klinnert, et al., 1983).

Results of the pilot study (Guile, 1987) support the notion that cognitive uncertainty precedes maternal referencing. Babies who referenced mother's positive expression and then approached the remote-controlled robot waited significantly longer than non-referencers to do so. However, these babies eventually spent just as much time manipulating and exploring the robot as non-referencers, indicating their ability to use maternal support to explore effectively. In contrast, other infants referenced mother but avoided the stimulus. They were not able to use her

display of emotional support to overcome initial uncertainty triggered by the unfamiliar stimulus.

Differential Impact of Positive and Negative Expressions. Babies respond more intensely to negative emotions expressed by others and attend for longer periods of time to fearful than happy faces (Nelson, 1987; Zarbatany & Lamb, 1985). Infants who receive negative maternal messages about stimulus toys are less likely to approach and play with these toys than infants whose mothers remain silent and neutral. However, infants who receive positive maternal messages are not necessarily more likely to approach and play with the toys than infants in the neutral condition (Hornick, et al, 1987). Behavioral variability associated with positive maternal affect is also observed in visual cliff studies: Almost all babies refuse to cross the cliff when mothers communicate fear, but not all infants cross in response to a joyful expression (Sorce, et al., 1985).

Alternative hypotheses. An alternative explanation proposed for results obtained in referencing studies is that maternal emotional signals modify the baby's general mood, instead of baby's specific appraisals of unfamiliar stimuli. In this view, mother's positive communication

> "may facilitate positive affect and approach behaviors to novel stimuli by providing a positively toned atmosphere in which the infant feels comfortable to explore, or ... may elicit a similar affective response in the infant -- "if mom is happy, then so am I" (Hornik, Risenhoover & Gunnar, 1987).

Evidence that babies understand that mother's communication relates specifically to the object which is the focus of their shared attention is provided by the finding that 12-month-old infants' play with stimulus toys is influenced by the positive or negative content of maternal messages, while behavior toward free-play toys available at the same time is not. That is, "infants whose mothers exhibited disgust were not more negative in mood; they merely avoided playing with the object of their mother's communication" (Hornik, et al., 1987).

Another explanation proposed to account for social referencing effects is that babies model or imitate maternal behaviors toward novel stimuli, without "constructing a more general interpretation of the meaning of stimulus events" (Walden & Ogan, 1988). However, the researchers cited immediately above argue that the imitation hypothesis is undermined by the fact that maternal signals do not consistently predict infant behavior.

Developmental Onset of Social Referencing

Babies observed in referencing experiments range from 10 months to two years of age. By 12 months, most babies reference in response to being confronted with a stimulus which engenders uncertainty (Klinnert, 1981). Only one study has provided data on the earliest developmental appearance of maternal referencing (Sorce, Emde & Frank, 1982). Videotapes from a longitudinal study of thirteen

infants confronted with a stranger were analyzed at monthly intervals from 6 to 18 months of age. It was not until 10 months of age that babies referenced -- "focusing on the stranger's face for an uninterrupted time followed immediately by fixating on the mother's face".

Perceptual, cognitive and social advances precede the relatively advanced ability to seek and use the mother's emotional guidance to cope with an unfamiliar object or person. Maternal referencing depends on two major developmental achievements:

(1) responding to the emotional messages communicated by positive and negative expressions and

(2) communicating with mother via expressions and gestures about objects and events external to their interaction.

Maternal referencing does not appear in the baby's repertoire until both abilities have been established.

Understanding the Meaning of Facial Expressions.

Mother's face cannot provide information until baby is able to comprehend the affective meaning inherent in different facial expressions. While infants react to the human face as a "perceptually interesting stimulus" from birth on (Klinnert, Campos, Sorce, Emde & Svejda, 1983), understanding of the qualitatively different messages signalled by discrete facial expressions develops gradually over at least the first two years (Nelson, 1987).

In the earliest months of life, the amount of visual information extracted from facial expressions is probably limited by the young infant's tendency to scan the outer contours of faces and to fixate on isolated facial features if attention is drawn to the interior of a face (Klinnert, et al., 1983). Nelson (1987) points out that while babies can discriminate contrasting facial configurations such as happiness, sadness and surprise by 3 months, this is not the same as responding to their emotional content.

An important cognitive advance occurs at about 4 months of age. At this time, babies start to discriminate faces presented right side up more easily than faces presented upside down. This indicates attainment of a scheme for faces distinct from schemes for other patterned stimuli (Nelson, 1987). At about 7 months, infants begin to "categorize" facial expressions of emotion (maintain recognition of an emotion across different models in experimental situations and across variations in intensity). Referencing studies demonstrate that twelve-month-old infants respond to the emotional content of maternal expressions. However, Nelson (1987) points out that this does not prove that one-year-olds discriminate the emotional valence of <u>different</u> negative and positive emotions.

<u>Development of preverbal communication between infant and caretaker.</u> The infant's ability to communicate with the caretaker about external events develops gradually over the

first year. Before nine or ten months, babies do not seek out the mother's reaction to objects and events in the environment. They attend either to the mother or to a third stimulus, not to both at the same time (Trevarthan, 1977; Tronick, 1980).

Parent-infant communication during the baby's first year begins with face-to-face interactions and culminates in exchanges regarding objects and experiences in their shared world. During the first weeks of life, a "complex, regulatory feedback system between newborn and caretaker" is reflected in an "intense mutual cycling of newborn alert behaviors and maternal attention behaviors" (Als, 1979). During face-to-face interactions with parents, infants engage in many short cycles of eye contact and looking away, making mouth movements and facial grimaces which resemble attempts at vocalizing and smiling. Body and hand movements often resemble "the gesticulations of adults in eager conversation".

Young infants' responses to inanimate objects are markedly different. One-month-olds stare at objects for longer periods of time, with "short bursts of vocalizing and jerky swipes of arms or legs", and then look away abruptly (Trevarthan, 1977).

The more advanced face-to-face exchanges between 2- to 5-month-old babies and their caretakers have been described as "proto-dialogues" and "preverbal conversations"

(Bretherton & Bates, 1979) because "features of the exchange ... suggest a conversation, [although] one without a specified topic" (Bullowa, 1978a). These conversation-like features include mutual gazing, turn-taking, reciprocity (partners' responses to one another are meaningful in the context of their interaction), rhythmicity and interest (Fafouti-Milenkovic & Uzgiris, 1979). Stern (1974) characterizes the absorbing face-to-face interactions between the 3-month-old baby and its caretaker as "games". Mahler, Pine & Bergman (1975) discuss "mutual cuing" -- a circular process of interaction allowing mother and infant to "empathically" read and respond to each other. However, despite the "complex dialogue-like structure" of these preverbal exchanges (Bullowa, 1978a), the 3-month-old's cognitive immaturity places limitations on the content of communication:

> "this type of interaction is devoid of interest in events or objects in the external situation, or in the activities of either or both partners on objects. It has no reference other than the direct exchange of expressions of mood in the person-person dyad, and it does not involve shared purpose with respect to objects" (Fafouti-Milenkovic & Uzgiris, 1979).

Babies' interest in participating in face-to-face exchanges peaks at three to four months. From 5 months of age on, they spend relatively less time engaging in conversation-like play with caretakers and more time practicing sensorimotor skills:

> "Interest in objects that the infant can grasp and manipulate may supplant to some extent interest in

> interacting exclusively with the mother" (Hubley & Trevarthan, 1979).

Exploring features of the physical environment comes to occupy about half of an infant's waking time (Fafouti-Milenkovic & Uzgiris, 1979). In a departure from earlier patterns of communication, infants of this age turn away from and avoid eye contact with caretakers (Trevarthan, 1977). In response, mothers start to make

> "frequent and prolonged attempts to join in the infant's activity by commenting on the baby's focus of interest, following his/her line of regard ... attempts to join in by the mother constitute a mechanism for establishing reference to objects and events external to the dyad" (Fafouti-Milenkovic & Uzgiris, 1979).

At 7 to 8 months, infants begin to communicate interest in objects through gestures such as pointing, showing, giving and reaching (Murphy, 1978; Tronick, 1980). The ability to attend to the mother and an interesting stimulus at the same time appears at about 9 months. Babies point to a person or object and "check back" with the mother before attending once again to the stimulus. More complex patterns of infant-caretaker communication now appear in which mutual attention to objects is combined with face-to-face play (Tronick, 1980).

In light of the developmental sequence outlined above, it is clear why maternal referencing is not observed before 9 or 10 months of age, when mother-infant communication begins to include external objects. Conventional gestures such as pointing are accepted as indicators that this

developmental milestone has been attained (Murphy, 1978). This "dramatic change" in mother-infant communication (Bakeman & Adamson, 1986) allows maternal referencing to play a potentially important role in infant exploration and learning.

For Stern (1985), a sequence of developmental changes during the first year in the infant's "subjective sense of self" underlies advances in interpersonal communication with others. He believes that infants undergo an extremely significant shift in awareness at seven to nine months of age, approaching the world with a totally different "organizing subjective perspective on self and other". At this time, baby begins to become aware that others have internal mental worlds which are separate and distinct. Baby's realization that "he or she has a mind and that other people have minds as well" sets the stage for the next step in baby's development, which is sharing experiences with others. Stern uses the term "intersubjective awareness" to refer to the infant's ability to not only attribute mental states (including emotions) to others but, more importantly, to share these mental states (including emotions) with others:

> "mental states between people can now be "read", matched, aligned with, or attuned to (or misread, mismatched, misaligned, or misattuned). The nature of relatedness has been dramatically expanded."

The baby's need for subjective sharing or intersubjectivity (Trevarthan, 1977) motivates all aspects of infant

psychological development from about nine months on. The fact that maternal referencing depends on baby's conception of mother as having emotions which can be accessed and shared places this phenomenon within Stern's interpersonal theory of infant development. Stern (1985) comments that babies would not look to mother in an uncertain situation "unless they attributed to her the capacity to have and to signal an affect that has relevance to their own actual or potential feeling states".

Age-related changes. Several studies provide evidence for developmental changes in maternal referencing, at least in response to a constant set of stimuli. Klinnert (1981) and Walden and Ogan (1988) both found that, compared to 12-month-olds, 18-month-olds are more likely to reference mother before responding to unfamiliar toys but are less likely to be influenced by maternal messages. Surprisingly, older infants who receive fearful versus happy maternal messages smile more and approach toys more rapidly. Social and cognitive advances may underlie these changes in maternal referencing. Older babies' looks to mother may be motivated by a need to share an experience with her rather than by the need to rely on her for information about stimuli which at 12 months might have aroused uncertainty. An 18-month-old who smiles and runs to a toy may think mother's exaggerated expression of fear is a joke. Whether older infants might show referencing effects noted in

younger babies under more "threatening" circumstances has not been examined. In any case, 12-month-olds, when they look to mother, are more likely to regulate their behavior in agreement with maternal signals. This dissertation research is not intended to provide evidence on stability of differences in maternal referencing across age.

Changing Definitions

The original formulation of the referencing hypothesis holds that the need to reduce cognitive uncertainty motivates the infant to seek information from the mother. The infant integrates this information with its own perceptions to arrive at an appraisal of the stimulus as benign or harmful. This appraisal in turn produces a behaviorally observable outcome (stimulus approach or avoidance). However, current research in this area deemphasizes the link between maternal referencing and subsequent infant behavior toward a novel stimulus. Experiments measure either (1) frequency of looking to mother under different conditions or (2) the impact of her unsolicited messages on infant behavior and ignore whether or not babies reference. Bradshaw, Goldsmith & Campos (1987) defend this approach, arguing that

> "Infants may not guide their behavior in accordance with signals they have sought, or may react to expressions imposed on them".

Identifying distinct cognitive and behavioral components of social referencing represents a conceptual

advance in understanding maternal referencing, but in terms of research design leads to less controlled experiments. First, many recent studies measure only information seeking -- how frequently the infant turns to the mother -- and do not carefully select stimuli used to prompt information seeking. Researchers employ stimuli such as loud noises or flashing lights which elicit surprise or startle responses in babies, not cognitive uncertainty reflecting conflicting desires to approach and avoid an intriguing stimulus (c.f., Bradshaw, et al., 1987).

Alternatively, other recent experiments focus solely on the behavioral outcome of maternal referencing -- the influence of mothers' affective expressions on infant behavior -- and do not control what and how mothers communicate. In these studies, it is not required that babies actively seek out their mothers' interpretations of unfamiliar events. In contrast with earlier research in which mothers posed peak expressions and remained silent, mothers are told to behave "naturally" and provide unsolicited messages via facial, verbal and gestural cues (c.f., Hornik, et al., 1987; Dickstein, et al., 1984).

Finally, the changes in research design discussed above make it likely that results obtained in such studies have little connection with the processes underlying maternal referencing -- e.g., the uncertain infant, looking to mother and using the information conveyed by her emotional signals

to arrive at a final appraisal of the stimulus. Eliminating the requirement that babies actively solicit maternal interpretations of ambiguous events suggests instead that compliance -- that is, the baby's desire to obey the mother's directives -- may account for results obtained in current research. In a discussion of their own research, Gunnar and Stone (1987) admit that because mothers issued commands to babies about whether to approach or avoid the stimulus toys their study "does not represent a pure test of affective social referencing independent of the effects of ... social influence".

Accounting for Individual Differences

The vast majority of referencing studies are conducted to determine whether infants' behavior toward novel stimuli can be predicted from the emotional content of maternal communications. The issue of infant differences has been ignored, even though main effects are difficult to demonstrate: About one-quarter of infants tested are regularly excluded from the data analysis because they fail to reference (c.f., Klinnert, 1981; Sorce, Emde, Campos & Klinnert, 1985; Zarbatany & Lamb, 1985; Hornik & Gunnar, 1988) and an equivalent percentage of infants do not behave in accord with maternal signals. Thus, at least half of the babies in studies published to date either do not reference or do not use the mother's facial expression as predicted (Nelson, 1987). The outcome is that groups of infants

exposed to contrasting maternal expressions (e.g., happy versus fearful) often fail to differ significantly on dependent measures (Klinnert, 1981; Gunnar & Stone, 1984; Hirshberg & Svejda, 1990). Nelson (1987) points out that infant differences in social referencing raise two issues. First, how do infants who look to mother for guidance differ from those who do not? The second issue concerns babies who do reference mother's face. How do babies whose behavior toward the novel stimulus corresponds with maternal affect differ from those whose behavior does not? Several researchers hypothesize that these differences are related to temperament or security of attachment.

Studies Relating Referencing to Infant Temperament. There is some evidence for a temperament-referencing relationship. Feinman & Lewis (1983) hypothesized that "easy" infants might be more influenced than "difficult" infants by positive maternal communications. Mothers' responses to Carey & McDevitt's (1978) Revised Infant Temperament Questionnaire (RITQ) classified babies as easy or difficult. Infants received either positive or neutral maternal messages about a stranger. In addition, half of the babies received messages directly (mother spoke to infant about stranger) and half indirectly (infant observed mother speaking in a positive or neutral manner to the stranger). Feinman and Lewis found that, compared to "difficult" infants, "easy" infants smiled at the stranger

more often in the positive than in the neutral condition but only when mothers spoke to them directly. "Easy" infants were also more likely to approach the stranger and offer her toys after receiving positive messages.

Bradshaw, Goldsmith & Campos (1987) also examined the role of temperament in maternal referencing, but obtained inconsistent relationships between various referencing measures and a positive/negative affect factor derived from Rothbart's (1981) Infant Behavior Questionnaire.

In a third study, Hornik & Gunnar (1988) classified infants as wary or bold depending on how readily they approached a large caged rabbit with mother present and observed information seeking. Wary babies referenced more frequently than bold babies, but only at the beginning of the trial.

Studies Relating Referencing to Security of Attachment. Two studies (Dickstein, et al., 1984; Bradshaw, Goldsmith & Campos, 1987) purport to examine the relationship between security of attachment and maternal referencing. Both studies hypothesize that the infant's ability to rely on the mother as a secure base from which to explore determines how readily her emotional communication is sought out and used in an uncertain situation.

Dickstein, et al. (1984) used the Strange Situation procedure (Ainsworth, Blehar, Waters & Wall, 1978) to determine attachment status among 19-month-old infants and

to measure frequency of looking to the mother in episode 3 (unfamiliar female adult joins mother and baby). They predicted (1) that securely attached babies would reference mother at a high rate when first confronted with the unfamiliar adult, but less frequently as the episode progressed, (2) that insecure-resistant babies would persist in a relatively high level of referencing throughout the episode, and (3) that insecure-avoidant babies would reference least frequently throughout.

The above predictions received some support, although differences were not significant. During the second minute of episode 3, the rate of referencing among insecure-resistant babies increased relative to Minute 1 while the rate of referencing among insecure-avoidant and secure babies decreased. Dickstein and colleagues attributed "the heightened and persistent referencing" of insecure-resistant babies to their "general anxiety and uncertainty ... combined with an inability to use the mother as a quick source of reassurance".

In another study, Bradshaw, Goldsmith & Campos (1987) also predicted that looking to the mother for help in coping with unexpected events (a loud whistle, window blinds dropping, lights flashing, etc.) would be greatest among resistant infants, least among avoidant infants and intermediate among secure infants. The data did not support this hypothesis, but it is not clear why babies' reactions

to stimuli eliciting startle or surprise should be influenced by attachment security.

This study also found no relationship between attachment and babies' tendency either to cross the visual cliff (in response to positive signals) or to avoid a remote-controlled spider (in response to negative signals).

Procedures used in the Bradshaw study clearly limit its ability to provide data on attachment and referencing. First, the study assessed looking to mother and infant approach behavior in separate situations and in response to very different stimuli. The study employed abrupt, unexpected events rather than more ambiguous stimuli which might create uncertainty to prompt information seeking. Finally, the study assessed the impact of maternal messages on infant behavior in an unrelated situation during which baby had to decide whether to approach or avoid the deep side of the visual cliff. However, Bradshaw and colleagues did not record whether babies in fact sought out mother's signals in this situation.

Other procedures prevented babies from displaying differences in the Bradshaw study. The negative affect "spider" episode did not allow proximity-seeking to the mother to be separated from stimulus avoidance; babies were initially positioned next to their mothers and almost half never moved away from her. And, the "unusually high proportion of non-crossers to the smiling signal" (30% of

infants in this study refused to venture onto the deep side of the visual cliff) most likely occurred because babies were subjected to six minutes of startling, abrupt events immediately before the visual cliff condition.

Finally, in both studies summarized above the proportion of infants classified as insecure-avoidant (A) or insecure-resistant (C) was disproportionately small relative to the number of securely attached (B) infants. The Bradshaw sample of 48 12-month-olds included 41 B babies, but only 4 A and 2 C babies. Likewise, in Dickstein's sample of 43 19-month-olds, there were 29 B, 6 A and 8 C babies.

The studies summarized above shed little light on whether infant referencing differences may be a function of attachment security. However, even if a relationship does exist, well designed research might not detect it. This is due to the fact that very different levels of measurement are implicit in these variables. Maternal referencing is a single unit of behavior (looking at the mother, or, in the fuller sense, looking and then approaching or not approaching the uncertain stimulus), while security of attachment is a broad psychological construct inferred from patterns of behavior.

A more fruitful approach to assessing the relationship between referencing and attachment security might be to classify infants by attachment subtype (Ainsworth, et al.

1978). Two to four distinct patterns of infant behavior are subsumed under each of the three main attachment groups (secure, insecure-resistant and insecure-avoidant). If using the narrower subtype classifications reduces within-group heterogeneity, between-group differences, if any exist, might emerge more clearly.

The present study used an alternative approach. This approach related infant social referencing to a dimension of mother-infant interaction which is theoretically linked with attachment but which corresponds in level of measurement to social referencing. Two areas of attachment theory and research are relevant here. First, infant exploration and attachment are intimately connected; babies are emotionally free to explore the outside world only to the extent that they can trust a warm, safe and supportive environment to meet their needs (Bowlby, 1969). Second, qualitative differences in attachment security and exploration at one year are associated with specific differences in maternal behavior and day-to-day mother-infant interactions (Ainsworth, et al, 1978). The fact that infant social referencing occurs in exploratory contexts suggests that the maternal behaviors which influence infant motivation to explore -- e.g., maternal availability and support for infant autonomy -- also influence how readily baby seeks out and uses mother's support in an uncertain situation.

It should be noted that exploration and autonomy are particularly salient developmental issues at the age when babies are studied in referencing experiments. Increasing motor skills, which allow one-year-olds to venture away from the caretaker, prompt psychological separation as well. The "practicing" subphase of separation-individuation (9-14 months) (Mahler, Pine & Bergman, 1975), is a period "in which the exploration of the environment, animate and inanimate, and the practicing of locomotor skills are highly invested with libidinal energy". For Piaget, one-year-olds are at Stage 5 of sensorimotor development. The essence of this stage is

> "a very active, purposeful, trial and error exploration of the real properties and potentialities of objects, largely through the relentless search for new and different ways of acting on them; the child has a resolutely experimental, exploration-and-discovery oriented approach to the outside world" (Flavell, 1977).

Maternal Characteristics and Infant Motivation to Explore

The positive impact of maternal availability on infant exploration is demonstrated by two findings. Infants are more likely to explore and enjoy an unfamiliar environment if the mother's face is visible and thus available for referencing (Sorce & Emde, 1981). In fact, if given a choice between playing with interesting toys and maintaining face-to-face contact with mother in an experimental setting, infants tend to choose being able to see mother's face (Carr, Dabbs & Carr, 1975).

In their detailed observations of mother-infant interaction in day-to-day situations, Ainsworth and her colleagues (1978) identified four dimensions of maternal behavior which influence the development of infant autonomy and motivation to explore:

- Sensitivity - insensitivity
- Acceptance - rejection
- Cooperation - interfering
- Accessibility - ignoring

Observations of home interactions revealed that mothers of securely attached (B) babies are consistently sensitive and responsive to the baby's needs. They accept the baby as a separate and different individual. They avoid interfering with the baby's activities but at the same time communicate availability by responding to bids for reassurance. Both at home and in the strange situation, babies of these mothers spend much time engaged in exploratory play. On problem-solving tasks they display enthusiasm, enjoyment and persistence.

In contrast, mothers of insecure-resistant (C) babies are "conspicuously insensitive to infant signals and communications" and therefore "highly inaccessible and ignoring". Their babies cry more often and experience more intense separation anxiety both at home and in the strange situation. Distress prevents them from using mother as a secure base; exploration and enjoyment of novel situations

is suppressed. They tend to be wary and fearful with strangers.

While mothers of insecure-resistant (C) infants are poor in choosing when and how they respond to their infants, mothers of insecure-avoidant (A) babies are actively rejecting. They rebuff "infant desire for close bodily contact", appearing to find physical contact unpleasant. These mothers are rigid and compulsive and communicate much anger and irritation. Insecure-avoidant babies are angry in turn because their attachment needs are "chronically frustrated". This anger is manifested in keeping at a distance from the mother throughout the strange situation, but most notably in the reunion episodes.

Numerous studies document the positive impact of maternal sensitivity, acceptance, cooperation and accessibility on infant socio-emotional development. For example, Grolnick, Frodi & Bridges (1984) found a significant relationship between infant motivation to master challenging tasks and "maternal control style" -- the mother's tendency to undermine or support infant autonomy. They found that mothers of babies who display persistence, competence and positive affect during free play are highly autonomy-supporting and sensitive. Slade (1987) also demonstrated that maternal involvement fosters infant development. In her study, mothers who were actively involved in free play had toddlers who displayed more

complex levels of play and played with toys for longer periods of time. MacTurk, McCarthy, Vietze & Yarrow (1987) point out that maternal support for exploration has an important outcome during infancy: When the mother helps the baby experience pleasure in learning situations, this motivates the infant to become increasingly competent by persisting in goal-directed behaviors. Ainsworth summarizes the central message of this research:

> "The most important aspect of maternal behavior ... is manifested in different specific ways in different situations, but in each it emerges as sensitive responsiveness to infant signals and communications" (p. 152).

Purpose of This Research

The general issue examined in this study was whether maternal behaviors which other researchers have identified as affecting infants' general motivation to explore and master the environment are also related to the more specific task of coping with an unfamiliar, potentially uncertainty-arousing stimulus in her presence. The assessment of "maternal interactive style" in this study borrows from Dunst's "Caregiver Styles of Interaction Scales" (1986). These scales place the caregiver's mode of interacting with baby during free play on a continuum ranging from passivity to joint action with child to caregiver control and manipulation. While this study did not assess mothers on Dunst's twelve styles, the researcher based her videotape coding approach on Dunst's notion that (1) specific maternal

behaviors can be identified which may function to promote or discourage infant independence and (2) these behaviors may be conceptualized as reflecting two independent dimensions: (1) the degree to which mother attends to and participates in baby's play (Ainsworth's Accessibility-Ignoring dimension) and (2) the degree to which she encourages baby's independence by allowing baby to initiate, control and direct play (Ainsworth's Cooperation-Interfering dimension).

The present research attempted to determine whether maternal accessibility and promotion of infant autonomy during free play are related to differences among babies in (1) seeking information from the mother prior to responding to an ambiguous stimulus and (2) approaching the stimulus in accord with her positive expression. The experimenter assumed that the degree to which mothers are accessible and promote infant autonomy during free-play correlated with maternal interest in infant activity and support for infant exploration outside the laboratory.

The research employed videotapes of 15-minute episodes of mother-infant free play to assess maternal interactive play style. Videotape analysis coded maternal behavior during free play at each 5-second marker of the 15-minute episode (12 codes per minute for a total of 180 scores per mother). Mother received a score for one of the three behavioral categories listed below at each 5-second marker.

(1) **Non-Participating:** Mother is either involved in an activity which does not involve baby and does not attend to baby or passively observes baby's play.

(2) **Autonomy-Promoting:** Mother allows baby to initiate, control and direct play. Her participation consists of demonstrating positive emotional involvement in baby's play through expressing interest and voicing pleasure at baby's successes. If she joins in toy play, baby determines which toys they will attend to and when. Mother provides cues which help baby to develop strategies and motor skills.

(3) **Autonomy-Undermining:** Mother attempts to control and direct child's play. She limits opportunities for child-initiated play by trying to influence which toys baby plays with and how he/she plays with toys. She performs actions for baby.

The 180 scores recorded for each mother were combined to produce two overall scores: Non-Participating and Autonomy Promoting:

(1) Non-Participating score: The number of intervals scored NP divided by the total number of intervals scored (T): NP / T

(2) Autonomy-Promoting score: The number of times the mother's behavior was scored AP divided by the sum

of the frequencies she received for AP and Autonomy-Undermining behaviors: AP / (AP + AU). Thus, the AP score reflects the proportion of mother's active play interventions which were autonomy promoting.

A description of the specific behavioral codes and scoring procedures can be found in Appendix A.

Additional Correlates of Individual Differences. Two additional variables were measured in this research in order to explore potential correlates of infant social referencing which are conceptualized as residing more "within" the infant than between infant and mother. Babies' responses in uncertain situations may be related to infant variables (temperament, cognitive ability) as well as to maternal characteristics (e.g., mother's style of interacting during free play).

The first hypothesis tested predicted that maternal referencing is related to infant temperament variables, specifically activity level and typical approach/withdrawal responses to novel stimuli. Kagan (1991) postulates that infant dispositions to approach or to avoid unfamiliar events are not only moderately stable over time but are "associated with distinct, physiological profiles that may be under partial genetic control". Kagan argues that the stability over the first two years of extreme infant responses to unfamiliar stimuli (motor activity/crying)

supports the idea that cortical factors underly the "actualization of the temperamental categories called inhibited and uninhibited to the unfamiliar". Babies who reference numerous times but avoid the robot may tend to be fearful in most new situations and/or less active than babies who eagerly approach the robot after referencing briefly or not at all. Regarding activity level, Feinman & Lewis (1983) found significant negative correlations between frequency of referencing and infant activity level, with active babies looking to mother less frequently.

For the present study, mothers rated babies on the Activity Level and Approach/Withdrawal subscales found in the Toddler Temperament Scale (Fullard, McDevitt & Carey, 1978) (see Appendix B). These subscales require mothers to estimate the frequency of twenty-two behavioral items on 6-point scales. Separate scores are calculated for Activity Level and Approach.

The experimenter chose the Toddler Temperament Scale (TTS) from a number of instruments available for infants and young children for two main reasons. First, it is the only temperament measure specifically designed for 12- to 36-month-olds. Second, in terms of reliability it compares favorably with other temperament scales (Hubert, 1982). One month test-retest reliability is .88 for Activity Level and .89 for Approach; internal consistency is also acceptable (Activity Level: .70; Approach: .86). Psychometric data was

obtained using a relatively large N (309 children). Evidence that maternal bias is not a serious concern with this instrument is indicated by significant correlations between maternal and independent observers' ratings (Fullard, McDevitt & Carey, 1984). A number of items are reversed to control for acquiescence.

It should be pointed out that the TTS, like all temperament measures, clearly does not assess purely innate or biologically-based infant differences. While maternal bias does not appear to seriously compromise babies' ratings (as indicated by evidence for external validity of maternal ratings), the fact remains that in one-year-old infants neither activity level nor approach to novel stimuli are independent of parent-infant interaction and home environment during the first year. However, this issue is relatively unimportant both in current discussions of temperament (Goldsmith, et al., 1987) and this research. If temperament ratings reflect stable differences among infants (e.g., differences which exist outside the laboratory setting), then any relationships found between maternal referencing and infant temperament measures support the notion that maternal referencing is linked with infant characteristics; whether or not they are biologically based is immaterial.

The second hypothesis tested predicted that cognitive maturity is implicated in babies' responses to unfamiliar

stimuli. In a review of Piaget's theory of cognitive development, Flavell (1977) explains that

> "the Piagetian infant becomes progressively more cognitively extroverted or external-world-oriented; that is, he becomes more concerned with exploring and discovering the real, objective properties of external things."

A cognitive explanation of social referencing predicts that the degree of uncertainty an infant experiences when confronted with a novel stimulus depends on its experience with and mental capacity to assimilate unfamiliar objects. If this is the case, then babies who reference infrequently may be more cognitively advanced than babies who need to reference mother numerous times. Whether or not baby approaches the robot in response to maternal signals could also be an outcome of level of cognitive functioning. More cognitively mature babies would not experience uncertainty over the robot and could approach it even if they do not reference. Babies who are less cognitively advanced might be unable to resolve their uncertainty even while receiving maternal encouragement.

This research examined a central aspect of cognitive development known as object permanence or object constancy. Object permanence -- conceiving of objects as continuing to exist even when they are not present to perception -- is central to the child's ability to understand and act on the external environment and "may be considered a Piagetian equivalent of a major developmental trend both in its

interrelationships with other abilities and in its future consequences" (Sexton, 1985). Advances in object permanence appear to precede advances in other sensorimotor abilities and predict later Stanford-Binet scores as well.

In Piagetian theory, the object concept is not innate but acquired gradually over the sensorimotor period (birth - 24 months). In the earliest weeks of life,

> "the young infant's world is one without objects as we know them; it is a world of pictures which disappear and reappear capriciously, lacking substantial permanence and spatial organization ... only gradually, the infant begins to conceive of objects as substantial and permanent, as external to the self and independent of the activity intermittently applied to them" (Uzgiris, 1973).

With increasing experience in physically and mentally manipulating the external world, the infant's interactions with the environment become increasingly organized and complex. Development of object constancy follows a "universal, fixed sequence of developmental stages or subacquisitions, the infant picking up different aspects or components of the full concept at different stages" (Flavell, 1977).

The study used babies' performance on Situations 8-10 of the Uzgiris-Hunt Object Permanence Scale to index level of object permanence (the Object Permanence Scale is one of the Ordinal Scales of Psychological Development (Uzgiris & Hunt, 1975, 1987). These scales are Piagetian-based measures of six separate domains of sensorimotor development. They contain very carefully constructed and

validated assessment procedures, consisting of "eliciting situations" which allow the infant to exhibit the "critical actions" which indicate developmental level attained for the seven sensorimotor abilities.

The Uzgiris-Hunt Scales are the most widely accepted measures of sensorimotor development developed for studying cognitive development up to two years of age. They both reflect and confirm Piaget's theory, which holds that (1) an invariant, ordinal sequence of attainments occurs with respect to each area of sensorimotor development and (2) that earlier attainments are subsumed by later attainments. The scales are highly reliable. Reliability of scores assigned infants in various Object Permanence situations ranges from 88% - 100% for interobserver agreement and from 75% - 94% for intersession stability. Intrinsic validity is demonstrated by the fact that, as babies mature, they proceed through the tasks in the same simple to complex order. Concurrent validity is demonstrated by high correlations with the Bayley Scales of Infant Development and predictive validity by significant correlations with Stanford-Binet performance at 2 1/2 years (Sexton, 1985).

Situations 8-10 of the Object Permanence Scale require an infant to retrieve objects hidden through an increasingly challenging sequence of visible and invisible displacements (see Appendix C). By twelve months of age, normally-developing babies begin to infer an object's final location

after such a series of visible hidings, but they differ in their ability to complete this task (Uzgiris & Hunt, 1975). The research assigned babies a single score reflecting their progress vis-a-vis successfully locating a hidden object (See Appendix C). The experimenter followed assessment and scoring procedures outlined in A Clinical and Educational Manual for Use with the Uzgiris and Hunt Scales of Infant Psychological Development (Dunst, 1980).

Review of Outcome Variables

The goal of this research was to determine whether maternal and/or infant predictors are related to the two central outcome variables observed when baby is placed in an uncertain situation:

1. Whether or not baby seeks out mother's affective reaction.
2. Whether baby approaches robot.
3. How quickly infant approaches robot (latency).

Review of rationale for hypotheses:

The primary hypotheses tested in this research predicted that both infant referencing frequency and infant approach behavior in the robot episode would be related to maternal interactive style in the free play episode ("maternal play style"). The pilot study indicated that one-year-old babies confronted with an unfamiliar stimulus do not necessarily look to mother for guidance. In fact,

- one-quarter of babies tested in the pilot study approached the robot without first referencing mother and
- these "non-referencers" approached the robot more quickly than babies who referenced mother.

The experimenter's subjective impression on reviewing the pilot videotapes was that babies who referenced infrequently or not at all were especially confident in coping with the laboratory situation. This impression led her to speculate that temperament and/or early socialization factors might be implicated in how babies responded to the unexpected appearance of the remote-controlled robot. Greater infant autonomy in the laboratory vis-a-vis robot exploration might be linked with a more general tendency to approach novel stimuli in day-to-day life. This more general tendency could be due to temperament factor(s) and/or to experiencing a high degree of parental support for exploration during the first year. Alternatively, babies might look to mother for information rather than emotional support. In this scenario, level of cognitive development might be related to baby's need for clarification in an uncertain situation.

For all hypotheses regarding frequency of infant looks to mother, babies were coded as "low" versus "high" frequency referencers. "Low" frequency referencers looked

to mother not at all or once; "high" frequency referencers looked to mother more than once. A preliminary analysis of the data indicated that babies who referenced only one time had more in common with babies who did not reference than with babies who referenced more than once.

Hypotheses regarding infant referencing frequency in the robot episode:

1. **Infant referencing frequency and maternal play style:** During free play, mothers of low versus high frequency referencers were predicted to be:
    a. significantly more Autonomy Promoting and
    b. significantly less Non-Participating.
2. **Infant referencing frequency and infant temperament:** Mothers of low versus high frequency referencers were predicted to rate their babies on the temperament scales as:
    a. higher on Approach and
    b. higher on Activity.
3. **Infant referencing frequency and infant cognitive development:** Low versus high frequency referencers were predicted to score higher on Object Permanence.

Hypotheses regarding infant approach behavior:

Infant approach behavior refers to whether, upon referencing mother's positive expression, the infant approaches or avoids the robot. However, hypotheses

regarding infant approach behavior apply to referencers and non-referencers. A chi-square analysis of the pilot data revealed that referencing and robot approach were independent; babies who referenced mother's encouraging face were not more likely to approach the robot than babies who did not look at her face.

4. **Infant approach behavior and maternal play style:**

It was predicted that, during free play, mothers of babies who approached versus avoided the robot would be:

a. more Autonomy-Promoting and

b. less Non-Participating.

5. **Infant approach behavior and temperament:**

It was predicted that mothers of babies who approached versus avoided the robot would rate their babies on the temperament scales:

a. higher on Approach and

b. higher on Activity.

6. **Infant approach behavior and infant cognitive development:**

It was predicted that babies who approached the robot would demonstrate more advanced Object Permanence than babies who did not approach the robot.

Latency to approach uncertain stimulus. Latency scores (reflecting how rapidly infants approached the toy robot) were highly variable in the pilot study. Some babies allowed only a second or two to elapse before approaching

the robot; others waited substantially longer to go to the robot after it entered the room.

The following predictions were made for babies who approached the robot during the course of the trial:

7. **Latency to approach robot and maternal interactive style:**

   Latency to approach the robot would be:

   a. negatively correlated with maternal Autonomy-Promoting and

   b. positively correlated with maternal Non-Participating scores.

8. **Latency to approach robot and infant temperament:**

   Latency scores would correlate:

   a. negatively with Approach (maternal ratings) and

   b. negatively with Activity scores.

9. **Latency to approach robot and infant cognitive development:**

   Latency to approach the robot would correlate negatively with Object Permanence.

CHAPTER II

Method

Sample

The final sample included 26 white, middle to upper-middle class mother-infant pairs (13 females; 13 males). Babies ranged in age from approximately 11 months (minimum: 45 weeks) to 15 months (maximum: 62 weeks); their median age was 53 weeks. The experimenter recruited infant-mother pairs from a variety of sources (flyers placed in pediatricians' offices, flyers handed out at play groups, personal referrals, etc.). The experimenter briefly interviewed any mother who expressed interest over the telephone to confirm that she was the primary caretaker and that her baby was not familiar with the stimulus chosen to create uncertainty in the experiment.

Procedure

A laboratory with a one-way mirror served as the data collection site. Before the study proper began, the lab was set up as a playroom with a colorful and humorous cat poster on the wall and a low bookcase filled with appealing toys and objects (none of which were used in the research). Most babies made a beeline for the toys when they entered the laboratory; a research assistant was available to interact with baby while the experimenter reimbursed mother for transportation expenses, reviewed with her an outline of the

study and asked her to sign a consent form. The experimenter then trained mother to pose the peak facial expression for joy/happiness (Ekman & Friesen, 1975) employed in the referencing episodes. The purpose of this training was to control for and maximize the emotional information conveyed to babies. The experimenter showed mother three photographs of a model displaying increasingly intense expressions of happiness and asked her to pose the most intense expression with the help of a hand mirror (see Appendix D). The experimenter modelled the components of the expression and reviewed with mother an outline of what she should do during the trial.

After a brief interim during which mother, baby and research assistant waited outside while the experimenter readied the laboratory, the episodes were presented in the following order:

1. **Robot episode** (designed to assess infant differences in maternal referencing).
2. **Free play episode** (designed to assess maternal differences in play style).
3. **Object permanence task** (assessment of an aspect of infant cognitive development).
4. **Dinosaur episode** (included to provide evidence regarding stability of behaviors observed in episode 1).

5. Finally, mothers completed the **Approach** and **Activity Level** temperament scales.

Assessment of Infant Differences in Maternal Referencing

The research focused on individual differences among infants in referencing-related behaviors in response to an unfamiliar object which was the target of mother's positive communication. The uncertainty-provoking stimulus was a 6 1/2" high remote-controlled plastic robot marketed as "Talkabot" which makes a whirring noise as it moves around. The robot was concealed behind a cloth covering a low wooden cube in the experimental room. None of the infants paid any attention to this cube before the robot emerged.

To begin the episode, mother settled baby on an X marked with tape on the floor and encouraged baby to play with two toys placed next to the X. As soon as baby was settled, mother sat on the floor approximately six feet from baby. When the robot appeared and eventually stopped, the position of mother, infant and robot formed an equilateral triangle.

The experimenter stood behind the one-way mirror to manipulate the remote-controlled robot. She moved the robot out of its hiding place immediately after mother and infant

were settled in their respective places.[1] The experimenter watched the baby, moving the robot in a random pattern for 30 seconds after baby first became aware of the robot's presence and then stopping it at a designated point equidistant from mother and infant.[2] The robot moved around in front of but did not go right up to infants (see Figure 1).

Mother looked alternately at the robot and infant, posing the joyful facial expression until a prearranged cue signalled her 60 seconds after the infant first noticed the robot to adopt a neutral facial expression. She had been told she could look at baby and respond to bids for physical contact as long as she maintained the neutral expression (see Appendix E). Baby was free to move about the experimental room in any manner; mother remained seated.

The trial ended 2 1/2 minutes after the infant initially became aware of the robot's presence in the room. At that time, the experimenter entered and encouraged mother to reassure any baby who continued to be wary of the robot.

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[1] The word "settled" instead of "seated" is used because several babies were not interested in sitting and were standing at the X when the trial began. The experimenter realized early on that studying toddlers in a laboratory situation demands some flexibility; it is unproductive to expect that children of this age will conform to an experimental protocol!

[2] The research assistant timed all segments with a stopwatch.

Measures employed in previous research on social referencing in infants (Klinnert, 1981) and associated with dramatic individual differences in the pilot study (Guile, 1987) were coded from videotapes of the robot episode.

Infant referencing:

(1) **Frequency of referencing:** How many times infant referenced mother before moving from initial position.

Infant approach behavior:

(2) **Direction of initial move:** Whether infant initially moved toward robot or mother.

(3) **Latency of initial move:** How many seconds elapsed between infant noticing robot and making first move toward either robot or mother. Time scores were obtained from a stop-watch superimposed on the videotapes.

Manipulation check. In order to confirm that mothers' emotional signals uniformly communicated joy/happiness, two independent raters compared mothers' videotaped facial expressions with the peak facial expression mothers had been asked to model (Appendix C). In order to be included in the study, mothers of babies who referenced must have posed an expression including the central components of the peak facial expression for joy/happiness (Ekman & Friesen, 1975): (1) corners of the lips are drawn back and up; (2) the mouth is parted with teeth showing; and (3) cheeks are raised. Four mothers did not follow instructions adequately. However, only one was eliminated from the study for this

reason; the other mothers' babies did not reference or equipment failure precluded use of the data.

Assessment of Maternal Play Style

The study assessed maternal interactive style during a 15-minute mother-infant free-play episode. The experimenter asked mother to pretend she was in her own home and to play (or not play) with baby as she "naturally" would at home, emphasizing that "anything goes" and specifically contrasting this episode with the rigid requirements of the robot episode. During this 15-minute episode the experimenter provided mother and baby with three age-appropriate but challenging toys:

1. **Shape-sorting toy -- Fisher-Price "Baby's First Blocks":**

   12 plastic blocks in three different shapes in a canister with shape sorting lid.

   Recommended age: 6-24 months.

2. **Cause-and-effect toy -- Playskool "Busy Poppin' Pals":**

   Box with five separate compartments containing Sesame Street characters -- Bert, Ernie, Big Bird, Cookie Monster and Oscar -- which pop out in response to pressing button, pulling switch, turning dial, etc.

   Recommended age: 1 1/2 - 3 years, but piloting indicated that toy elicits great interest among

one-year-olds. Although their cognitive/fine-motor skills are not advanced enough allow them to open all the compartments, babies in both the pilot and the dissertation research focused on the compartments which were easiest to pop open with intense preoccupation.

3. **Stacking toy: Mattel "Stack-a-Ball":**

Plastic rings of different colors which can be stacked on color-coded pole. Pole chimes when shaken.

Recommended age: 6 months - 3 years.

The experimenter selected the toys described above after considering many toys designed for infants and young children. Her primary goal was to choose toys which would maintain interest and involvement on the part of both mother and baby for an extended period of time. Piloting of the selected toys with five mother-infant dyads indicated that the toys successfully elicited both sustained infant interest and maternal involvement. The complexity and developmentally challenging aspects of the toys encouraged mothers to exhibit their autonomy-promoting tendencies vis-a-vis infant play:

(1) the toys provide many opportunities for interactive play (toy exchanges, coordinated attention, maternal suggestions and demonstrations, etc.) and

(2) the toys could be approached in a variety of ways corresponding to the developmental level of the child. For example, baby might not understand or have the necessary motor skills to adopt the most advanced strategy for using the shape-sorting toy, e.g., matching blocks with appropriately shaped openings in the shape sorting lid and dropping blocks through the lid into the canister. However, younger babies found this toy rewarding to play with by simply removing the lid and dropping the blocks directly into the canister (which is what most of the one-year-olds observed in this study did!). An important aspect of maternal interactive play style is whether mother can "hold back" and allow baby to play with toys using strategies within his or her developmental competence.

Videotape coding. A research assistant served as the primary coder of maternal play style. She was "blind" to babies' behavior in the robot episode, not having been present during the data collection. She had no knowledge of babies' scores on any of the study variables. The research assistant coded mothers' behavior during free play at each 5-second marker of the 15-minute episode (12 codes per minute for a total of 180 scores per mother). The coding method assigned specific behavioral items to more general

categories developed by analyzing pilot videotapes of free play. Mother received a score for one of three categories of behavior -- Non-Participating, Autonomy-Promoting and Autonomy-Undermining -- at each 5-second marker. Frequency counts obtained for the three behavioral categories were combined to arrive at two overall scores for each mother -- a Non-Participating and an Autonomy Promoting score (see Appendix A).

Reliability coding. In order to obtain estimates of interrater reliability, the experimenter independently rated eight of the 26 free-play videotapes initially coded by the primary coder. These independent ratings indicated a very high level of agreement for both the Non-Participating ($r = .88$, $p < .01$) and the Autonomy-Promoting ($r = .94$, $p < .001$) dimensions of maternal play style.

Other Measures

The experimenter administered the object permanence tasks which are described in detail in Appendix B. Finally, mothers completed the temperament scales (Appendix C).

After the data had been collected, the experimenter debriefed the mother about the purpose of the study, answered any questions she had and told her that a summary of study results would be mailed to her when all study data had been analyzed.

The experimenter mailed mothers a thank-you note within a week of their participation in the study.

CHAPTER III

Results

Review of Variables Measured in Study

Results are reported for the following variables measured in this research:

Infant Variables:

Exploratory behavior. The research obtained three measures of infant behavior during a 2 1/2 minute situation in which a remote-controlled toy robot appeared unexpectedly and mother communicated positive affect via her facial expression. At the beginning of the trial, baby sat or stood at one corner of an equilateral triangle (mother - robot - baby). When the robot appeared, most infants moved away from this initial position. The three infant measures were:

1. **Maternal referencing** (presence and frequency),
2. **Robot approach** (yes, no) and
3. **Latency** (time elapse) to approach robot.

Temperament. Mothers rated babies on items comprising the **Activity Level** and **Approach/Withdrawal** subscales found in the Toddler Temperament Scale (Fullard, McDevitt & Carey, 1978) (see Appendix B). Infants received a score on each subscale.

Object permanence concept development, as indexed by infant performance on Situations 8 - 10 of the Uzgiris-Hunt Object Permanence Scale. Babies received a single score on this scale (see Appendix C).

Maternal Variables:

Maternal Play Style. Two dimensions of maternal behavior were coded from videotapes of the 15-minute free-play episode during which mothers and babies played with three toys described in the previous chapter.

- Non-participating
- Autonomy Promoting

Reporting of Results

Results will be reviewed in the following sequence:

1. **Infant behavior in the robot episode:**
   - Infant referencing frequency
   - Infant exploratory behavior (robot approach and approach latency)
2. **Evidence for stability of infant differences identified in the robot episode.**
3. **Evaluation of hypotheses:**
   - Discussion of the potential impact of infant age and gender on results.
   - Relationships between infant referencing and exploratory behavior in the robot episode vis-a-vis:

- maternal play style,
- infant temperament and
- infant cognitive development.

Statistical tables referred to in the text below appear at the end of this Chapter.

Infant Behavior in the Robot Episode

Infant Referencing Frequency. Of initial interest was the incidence of social referencing in the sample of infants observed in this study. About two thirds (18/26 or 69%) looked to mother after the robot appeared and before moving toward her or the robot (Table 4, p. 68). Most infants who referenced mother did so once (35%), twice (12%) or three (19%) times (Table 5, p. 69). Only one baby referenced more than three times.

Infant Exploratory Behavior. Just under half of the babies (11/26 or 42%) went to the robot when it appeared. The rest either went directly to mother (11/26 or 42%) or displayed conflicted behavior, remaining in the vicinity of the X (4/26 or 16%). Half of babies tested (50%) approached the robot at some point during the trial. All infants who approached the robot touched and explored it, either immediately or after some hesitation (Table 4, p. 68).

Infants who approached the robot differed greatly in how rapidly they did so after becoming aware of the robot in the room. Scores on this variable ranged from 3 to 43 seconds (Median = 10 seconds).

The majority of babies (73%) approached mother during the robot episode -- often pushing the robot to her or toddling to her side and pointing toward the robot (Table 4, p. 68).

Of babies who referenced mother, 39% approached the robot. Of babies who did not reference mother, 50% approached the robot. A chi-square test of the contingency data presented in Table 6 (p. 70) indicates that robot approach was not related to referencing mother's encouraging facial expression (^{2} (1, N = 26) = .01, p > .15). In fact, babies who approached the robot tended to look at mother fewer times than babies who avoided the robot (.9 vs. 1.6 times), t (24) = 1.45, p < .08, one tailed.

Evidence for stability of individual differences. In order to determine whether behaviors observed in the robot episode reflected more than situation-specific responses on the part of babies observed in this study, the experimenter presented a second stimulus (a wire-controlled toy dinosaur) to babies. The dinosaur appeared unexpectedly in a second trial placed at the end of the episodes observed in the laboratory. Although this dinosaur episode differed substantially from the robot presentation (e.g., the experimenter controlled the dinosaur from inside the experimental room and the dinosaur appeared after babies had spent about one-half hour in the laboratory), babies' stimulus approach behavior was similar in these two episodes

separated by about twenty minutes, $r\ (26) = .57$, $p < .01$. Referencing frequency correlated .45 ($p > .05$).

Evaluation of Hypotheses

Potential Impact of Age and Gender. Statistical tests of the data presented in Table 7 (p. 71) and Table 8 (p. 72) indicated that infant age and gender did not covary with any of the study variables (except age with level of object permanence, which would be expected). All subsequent analyses were therefore performed on the total sample of 26 infants.

Relationships Between Infant Behavior and Maternal Play Style

The hypotheses predicted that two dimensions of maternal interactive style -- Non-Participating and Autonomy Promoting -- would be correlated with infant behavior in the robot episode. The original definition of Non-Participating included both ignoring and observing behaviors on the part of mothers. When an initial examination of the data set revealed that mothers very rarely ignored their babies, the researcher excluded this component from the Non-Participating variable. The Non-Participating dimension therefore refers solely to maternal observing. Statistical analysis failed to identify any significant relationships between maternal Non-Participating and infant variables (Table 9, p. 73; Table 10, p. 74). Where the term "maternal

play style" appears below, it refers exclusively to the autonomy promoting dimension unless otherwise noted.

Although no significant relationships were found between maternal Non-Participating and infant variables, it should be noted that the direction of results was opposite to that predicted. The hypotheses predicted that maternal Non-Participating would be posivitively correlated with both infant referencing frequency and robot avoidance. Instead, mothers of low frequency referencers and babies who approached the robot were more likely to simply observe baby's play. These results indicate that observing functions quite differently from ignoring baby's play and may, in fact, be autonomy promoting.

Autonomy-promoting scores assigned mothers varied substantially (Table 11, page 75); the percentage of active interventions made by mothers which were scored autonomy promoting ranged from 15% to 92%. The median percentage of maternal autonomy-promoting interventions was 51.5, while the mean was 55%.

Infant referencing frequency and maternal play style.

Analysis of the data revealed a significant relationship between infant referencing frequency[1] and

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[1] A one-way analysis of variance with three groups formed based on referencing frequency (0, 1, +1) indicated that babies clustered statistically into two groups: Babies who referenced not at all/once and babies who referenced more than once. Results are reported contrasting "low frequency referencers" (babies who looked to mother 0,1 times) with "high frequency

maternal play style. As predicted, mothers of low frequency referencers were significantly more Autonomy Promoting (M = 62) than mothers of high frequency referencers (M = 41), t (24) = 2.60, $p < .01$, one-tailed.

Infant approach behavior and maternal play style.

Robot approach. Mothers of babies who approached the robot as their first action were significantly more Autonomy Promoting (M = 64) than mothers of babies who did not initially approach the robot (M = 48), t (24) = 1.89, p <.05, one-tailed.

Approach latency. The relationship obtained between maternal play style and infant approach latency to the robot was in the hypothesized direction but was not statistically significant. Mothers of babies who approached the robot with less hesitation were somewhat more Autonomy Promoting (r = -.35). Two factors may prevent more accurate assessment of this relationship: (1) the range of maternal Autonomy Promoting scores was restricted for the sample of babies who approached the robot and (2) this correlation is based on a very small sample (the 11 babies who initially approached the robot). Table 12 (p. 76) summarizes the data regarding infant behavior and maternal play style.

Infant Behavior and Infant Temperament.

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references" (babies who look to mother more than once (+1 times).

Referencing frequency. Low frequency referencers were significantly more Approach oriented outside the laboratory (M = 2.02) than high frequency referencers (M = 3.24), t (24) = -3.64, $p < .001$, one-tailed.[2] Referencing frequency and Activity Level were not related, t (24) = .38, $p < .35$, one-tailed.

Infant approach behavior.

Robot approach. Babies who approached the robot as their first action were significantly more Approach oriented in general (M = 2.02) than babies who initially avoided the robot (M = 2.74), t (24) = -1.93, $p < .05$, one-tailed. Robot approach and Activity Level were not related, t (24) = -.36, $p < .35$, one-tailed.

Approach latency. Although babies who approached the robot more rapidly tended to be more Approach oriented (r = .51), this relationship was not statistically significant (n= 11). The relationship between Approach Latency and Activity Level was close to 0 (r = -.11). Table 13 (p. 77) summarizes the data regarding infant behavior and infant temperament.

Maternal play style and infant temperament.

Table 14 (p. 78) presents relationships obtained between maternal Autonomy Promoting scores and infant variables. The only significant relationship identified was

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[2] Lower scores on this scale indicate a greater tendency to approach unfamiliar people, objects, etc.

between maternal support for infant autonomy and infant Approach scores on the Toddler Temperament Questionnaire ($r = -.62$, $p < .01$).

Infant behavior and cognitive development.

Analysis of the data presented in Table 15 (p. 79) indicated no relationship between infant Object Permanence level and referencing frequency, t (19) = .75, $p > .05$, one-tailed; robot approach, t (19) = -1.18, $p > .05$, one-tailed; or robot approach latency, r (21) = -.18.

Overall Research Findings

In summary, the results of this research indicate support for the following hypotheses:

1. Infant referencing frequency is related to maternal interactive play style:
   - Babies who turned to look at mother **fewer times** before deciding whether to approach the robot tended to have **more autonomy promoting** mothers.
2. Infant approach behavior is related to maternal interactive play style:
   - Babies who initially **approached** rather than avoided the robot tended to have **more autonomy promoting** mothers.
3. Infant referencing frequency and approach behavior in the laboratory are also related to maternal perceptions of infant approach temperament.

- Compared with high frequency referencers, mothers of **low frequency referencers** perceived their babies as significantly **more likely to approach** unfamiliar people, objects, etc. during day-to-day encounters.
- Compared with babies who avoided the robot, mothers of babies who **approached** the robot also perceived their babies as significantly **more likely to approach** unfamiliar people, objects, etc. during day-to-day encounters. Maternal perceptions of infant temperament support the notion that infant behavior in the laboratory was not merely situation-specific but reflected characteristic behavioral tendencies.

Tables 1 through 3 on the following pages summarize the study hypotheses and findings.

Table 1

Summary of Results: Infant Behavior and Maternal Autonomy Promoting (A-P) Play Style

Predicted Relationship:	Predicted Relationship Confirmed?	Test Statistic
Infants who referenced at a low vs. high rate in the robot episode would have mothers who displayed more A-P behaviors during free play.	Yes	$t = 2.60$**
Infants who approached vs. avoided the robot would have mothers who displayed more A-P behaviors during free play.	Yes	$t = 1.89$*
Infants who approached the robot more rapidly would have mothers who displayed more A-P behaviors during free play.	No	$r = -.35$

* $p < .05$

** $p < .01$

Table 2

Summary of Results: Infant Behavior and Maternal Perceptions of Infant Temperament

Maternal perceptions of infant's general Approach orientation on the Toddler Temperament Scale	**Predicted Relationship Confirmed?**	**Test Statistic**
Predicted Relationship:		
Infants who referenced at a low vs. high rate in the robot episode would receive higher maternal Approach ratings.	Yes	$t = 3.64$**
Infants who approached vs. avoided the robot would receive higher maternal Approach ratings.	Yes	$t = 1.93$*
Infants who approached the robot more rapidly would receive higher maternal Approach ratings.	No	$r = .51$
Maternal perceptions of infant's Activity Level on the Toddler Temperament Scale		
Predicted Relationship:		
Infants who referenced at a low vs. high rate in the robot episode would receive higher maternal Activity Level ratings.	No	$t = -.38$
Infants who approached vs. avoided the robot would receive higher maternal Activity Level ratings.	No	$t = -.36$
Infants who approached the robot more rapidly would receive higher maternal Activity Level ratings.	No	$r = .11$

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

Table 3

Summary of Results: Infant Behavior and Infant Cognitive Development

Predicted Relationship:	Predicted Relationship Confirmed?	Test Statistic
Infants who referenced at a low vs. high rate in the robot episode would demonstrate more advanced concepts of object permanence.	No	$t = .75$
Infants who approached vs. avoided the robot would demonstrate more advanced concepts of object permanence.	No	$t = -1.18$
Infants who approached the robot a more rapidly would demonstrate more advanced concepts of object permanence.	No	$r = -.18$

Table 4

Infant Performance During Robot Episode

	Percent of Total Sample[a]
Referenced mother after robot appeared and before moving	69%
Approached robot as first action (regardless of referencing)	42
Approached robot during trial	50
Approached mother during trial	73

a_n = 26 infants.

Table 5

Infant Referencing During Robot Episode

# of Looks to Mother	n	Percent of Total Sample
None	8	31%
One or more	18	69%
One	9	35
Two	3	12
Three	5	19
Four	1	4

Table 6

Infant Referencing and Robot Approach

		Initial Robot Approach	
Referenced Mother	n	Yes	No
Yes	18	7	11
No	8	4	4

Table 7

Infant Gender and Study Variables

(Comparisons of Mean Differences)

Variable	n	Gender[a] Male	Female
# looks to mother	26	1.55	1.47
Approached robot as first action			
Yes	11	5	6
No	15	8	7
Robot approach latency	11		
M		14	18
Temperament			
Approach	26		
M		2.24	2.64
Activity	26		
M		4.57	4.79
Object Permanence	21		
M		3.6	2.9

a_n = 13 for each group.

Table 8

Infant Age and Study Variables

Variable	n	Mean Age (Weeks)
# looks to mother		
0/1 looks	17	54
2 or more looks	9	54
Approached robot as first action		
Yes	11	54
No	15	55
		Correlation with Age (Weeks)
Robot approach latency	11	.16
Temperament		
Approach	26	-.09
Activity	26	-.05
Object Permanence	21	.35*

* $p < .05$

Table 9

Infant Behavior During Robot Episode and Maternal Non-Participating (N-P) Play Style

Variable	n	Mean Maternal N-P Score
# looks to mother		
0/1 looks	17	53
2 or more looks	9	41
Approached robot as first action		
Yes	11	54
No	15	45
Correlation with:		
Robot approach latency	11	-.39

Table 10

Maternal Non-Participating (N-P) Play Style and Infant Variables

Infant Variable	n	Correlation with Maternal N-P Scores
Age	26	.31
Temperament		
Approach	26	-.37
Activity	26	-.22
Object permanence	21	.32
		Mean Maternal N-P Score
Gender		
Female	13	46
Male	13	52

Table 11

Maternal Autonomy Promoting (A-P) Scores

Highest score:	92	
	91	
	83	
	80	
	79	
	77	
	75	
	75	
	69	
	64	
	58	
	57	
		Mean: 55
	53	
		Median: 51.5
	50	
	48	
	47	
	46	
	43	
	42	
	39	
	38	
	32	
	32	
	26	
	22	
Lowest score:	15	

Table 12

Infant Behavior During Robot Episode and Maternal Autonomy Promoting (A-P) Play Style

Variable	n	Mean Maternal A-P Score	t
# looks to mother			2.60**
0/1 looks	17	62	
2 or more looks	9	41	
Approached robot as first action			1.89*
Yes	11	64	
No	15	48	
Correlation with:			
Robot approach latency	11	-.35	

* $p < .05$

** $p < .01$

Table 13

Relationship Between Infant Temperament and Robot Episode Variables

Variable	n	Mean Score: Approach	Mean Score: Activity
# looks to mother			
0/1 looks	17	2.02	4.72
2 or more looks	9	3.24	4.61
t =		3.64**	.38
Approached robot as first action			
Yes	15	2.02	4.62
No	11	2.74	4.73
t =		1.93*	-.36
Correlation with:			
Robot approach latency	15	.51	-.11

* $p < .05$

** $p < .001$

Table 14

Maternal Autonomy Promoting (A-P) Play Style and Infant Variables

Infant Variable	n	Correlation with Maternal A-P Scores
Age	26	.15
Temperament		
Approach	26	-.62*
Activity	26	.29
Object permanence	21	-.01
		Mean Maternal A-P Score
Gender		
Female	13	53
Male	13	57

* $p < .01$

Table 15

Relationship Between Infant Object Permanence (OP) and Robot Episode Variables

Variable	n	Mean OP Score
# looks to mother		
0/1 looks	14	3.06
2 or more looks	7	2.50
Approached robot as first action		
Yes	10	2.50
No	11	3.10
Correlation with:		
Robot approach latency	11	-.18

Note. Five infants could not be scored on the object permanence task.

CHAPTER IV

Discussion

The results of this research confirm and illuminate the findings of the author's earlier study (1987) of infant differences in maternal referencing. In addition to replicating the range of infant differences identified in the 1987 study, the present study determined that these differences are related to maternal interactive style during free play as well as to maternal ratings of the approach dimension of infant temperament. This research indicates that infant differences account for why social referencing experiments often fail to demonstrate significant main effects for maternal expressions. In both of the author's studies, some babies eagerly approached the robot without referencing; others looked to mother several times but were unable to approach and explore the robot. Only a minority of infants referenced mother and approached the robot. Clearly, maternal expressions do not consistently "regulate" infant behavior as the social referencing paradigm predicts (Klinnert, 1981). The narrative descriptions provided below indicate how very differently two babies responded during the social referencing portion of the research, even though each infant looked to mother after the robot appeared:

Baby # 1:

> Long stare at robot at it emerges from hiding place - brief glance at mother - looks back to robot - then to mother - robot - mother - robot - mother -

finally focuses gaze on robot for about 25 seconds. Suddenly drops toy she has been holding since beginning of trial - turns toward mother while pushing herself into a standing position - toddles to mother - looks back at robot and other toys while still standing next to mother - looks at mother's face, then at other toys while rocking back and forth on her feet - looks once again at mother's face, then leans against mother's knee - still rocking slightly - sits down on mother's knee - stares at robot - trial ends.

Baby # 2

Long, mesmerized stare at robot as it emerges from hiding place - looks at mother for a second - impact of looking at mother's happy face is like "flipping a switch": without hesitating, she goes right up to robot and peers intently into its face - puts her hand on the robot's head and shakes it a little - "examines" robot carefully with her back to mother - then turns so that she is facing mother and continues to examine robot - after a while appears to lose interest and looks around the room - briefly resumes examining robot, but then returns to play with other toys - goes back to robot - trial ends.

The 1987 study suggested that, when an infant is confronted with a novel, ambiguous stimulus, maternal referencing and stimulus approach may reflect infant temperament and/or the support babies gain from their relationship with mother. In the 1987 study, low compared to high frequency referencers approached the robot more rapidly, spent somewhat longer exploring the robot and somewhat less time in physical contact with mother. Striking differences were also noted in babies' emotional responses to being confronted with the robot. Some babies responded with fascination and curiosity; others were wary or even distressed. Persistent referencing and stimulus avoidance appeared to be manifestations of anxiety.

Informal observations of the confidence characterizing low frequency referencers' exploration as well as their positive interchanges with mother suggested that a relationship variable might be implicated in both frequency of referencing and approach to an unfamiliar stimulus. Based on the notion that the ability to use mother as a base for exploration reflects security of attachment, the experimenter hypothesized that, by one year of age, babies would not only demonstrate secure or insecure attachment to mother, but characteristic exploratory behavior in an unfamiliar situation as well. Some babies would exhibit confidence in coping with unfamiliarity while others would be less able to strike out on their own. Further, their exploratory behavior would be related to maternal interactive style. Mothers whose interactive play style expressed acceptance of and respect for baby as a separate and unique individual and who facilitated independent exploration would have emotionally secure, curious and actively exploratory babies.

The current research provides tentative answers to Nelson's (1987) questions: (1) How do infants who look less often to mother for guidance differ from those who reference persistently? and (2) How do babies whose behavior toward a novel stimulus corresponds with maternal affect differ from those whose behavior does not?

This discussion will center on three major issues raised by the research results: (1) the role of maternal support for infant independence in early personality development; (2) the link between infant behavior in the laboratory and temperament measures; and (3) the finding that infant referencing behavior and exploration are related to both maternal play style and infant temperament. Finally, the conclusion will summarize the overall implications of the research.

Maternal Support for Infant Independence

The results of this study support the hypothesis that maternal encouragement of infant autonomy during free play is related to one-year-old babies' exploratory confidence. Mothers who allowed babies to initiate, control and direct play and who expressed excitement and pleasure at babies' successes tended to have infants who referenced her infrequently when confronted with the robot. They also tended to have babies who approached the robot. On the other hand, more directive and controlling mothers who limited opportunities for infant-directed play tended to have babies who referenced persistently and who avoided the robot. As suspected in the pilot study, babies who referenced not at all or once were distinct from those who referenced more than once. A quick "check" with mother appeared to be qualitatively different than persistent referencing.

The current study is consistent with research demonstrating that maternal support for infant autonomy is related to infant socioemotional differences. For example, Grolnick, Frodi & Bridges (1984) found that one-year-olds who made persistent attempts to master challenging tasks were accustomed to interacting with an autonomy-supportive mother. These researchers speculate that mastery motivation is reinforced when babies themselves determine their responses to the environment. Mothers of babies who did not hesitate to explore in the present study may also encourage their infants to experience how their actions affect the environment, not "taking over" unless necessary.

Interacting with a parent who allows baby to experience freedom of choice begins to be very important toward the end of the first year. Virtually all descriptions of early psychological development stress autonomy as a developmental issue beginning around one year of age. Piaget's toddlers exercise cognitive curiosity through an experimental, trial and error exploration of objects (Flavell, 1977). Mahler, Pine & Bergman (1975) describe toddlers during the "practicing" subphase of separation-individuation as needing less direct physical contact with mother, exploiting new motor skills by actively moving away from her and becoming engaged in extended bouts of self-absorbed play. Interest in exploring the world is so pronounced that baby is "intoxicated with exploration", hence the phrase "the

toddler's love affair with the world". The independent toddler bounces back from knocks and falls and elation is a prominent mood. At times, baby seems oblivious of mother's whereabouts, although her absence does not usually go unnoticed; baby needs to return to mother to "refuel" emotionally.

Why does the infant need maternal support for autonomy at this time in order to develop most fully? In Erikson's theory of personality development (1950), the major task of infants during the second year is not only attaining behavioral autonomy but establishing a separate identity or self. Writers such as Winnicott, Mahler and Kohut provide detailed accounts of "psychological birth" during infancy which give mother a central role in baby's personality development. They speculate that very young babies are either merged psychologically with mother or possess the primitive psychic structures which later become elaborated into a "self". Kohut (1977) points out that theories which deny that the self has its roots in early infancy do not take into account the fact that "the human environment reacts to even the smallest baby as if it had already formed ... a self" and

> "we may well discover, as we investigate early states of infancy with more and more refined psychological means, that a rudimentary self is already present very early in life ... (Kohut, 1977, pp. 98-99.)

Development of the self involves a process during which baby slowly separates psychologically from mother while continuing to experience intimacy and trust in their relationship. This process depends not only on maturational forces springing from within the infant. Winnicott (1960) discusses the concept that mother herself must evolve in her parenting style vis-a-vis baby. Baby's earliest months are a time of total dependence. Maternal care supports the infant ego, enabling the baby to "live and develop in spite of his being not yet able to control ... what is good and bad in the environment" (Winnicott, 1960, p. 37). In Winnicott's memorable phrase, "there is no such thing as an infant" during this time:

> "The infant and the maternal care together form a unit ... whenever one finds an infant one finds maternal care, and without maternal care there would be no infant ... at the earliest stages the infant and the maternal care belong to each other and cannot be disentangled." (Winnicott, 1960, pp. 39-40).

This symbiotic relationship (Mahler, Pine & Bergman, 1975) gradually begins to lessen over the first year, maternal care becoming separate from

> "something which we then call the infant or the beginnings of a growing child ... the infant ego eventually becomes free of the mother's ego-support, so that the infant achieves mental detachment from the mother, that is, differentiation into a separate personal self (Winnicott, 1960, p. 42).

The mother travels along on her baby's journey from absolute dependence through relative dependence "towards

independence" by adapting to "meet the specific and developing needs of the infant towards whom she orientates" (Winnicott, 1960, p. 42). Baby's movement away from symbiosis with the mother -- "to relating to her as separate and not me" (Winnicott, 1960, p. 45) depends on mother's ability to separate psychologically as well. Before mother and baby can communicate via language, mother's nonverbal awareness and empathy for her baby's inner world are crucial. While empathy does not lose its importance, the development of intentional communication and language during infancy are supported by mother separating enough from her baby to reinforce baby for signalling its needs: "at the end of merging, when the child has become separate from the environment, an importance feature is that the infant has to give a signal." Mother's ability to respond to baby as a separate and unique individual and to meet baby on her/his developmental level are vital:

> "The crucial question concerns, of course, the point in time when ... the baby's innate potentialities and the self-object's expectations with regard to the baby converge. Is it permissible to consider this juncture the point of origin of the infant's primal, rudimentary self?" (Kohut, 1977, pp. 98-99) (my emphasis).

An appreciation of the development of self during infancy places the finding that Autonomy Promoting mothers have independent babies in a broader context. Any influence of mother's interactive or play style on baby is most likely mediated through the infant's developing sense of self. By

one year of age, baby has formed a mental representation of the reliability and trustworthiness of the caregiver based on numerous "microinteractions" between them (Stern, 1985). Ideally, mother responds to her baby's push toward greater independence by encouraging, within the security of their relationship, baby's need to explore and experiment on the world. If the toddler is accustomed to interacting with a sensitive mother who allows baby to "practice" separation from her motorically and psychologically, research indicates that baby will deal more confidently with the world (Winnicott, 1960; Mahler, Pine & Bergman, 1975).

Conceptualizing maternal play style as affecting baby only after it is filtered through the one-year-old's sense of self avoids reinforcing the simplistic notion that infants are passive recipients of parental influence. While the inequality of the infant-parent relationship implies that it is the parent's responsibility to encourage infant self-determination -- whatever the ultimate outcome -- this study did not find a perfect correlation between maternal play style and infant behavior. In fact, several babies' behavior did not correspond at all with maternal play style. They appeared to be "impervious" to their mother's interactive style. A few mothers who appeared to be Autonomy Promoting had timid babies, while a few Autonomy Undermining mothers had babies who ignored their mothers' attempts to direct their activities and proceeded to insist

on doing exactly what they wanted to do! In one case, the mother mentioned that the father played very differently with baby than she did, which is a healthy reminder that baby experiences many influences besides mother. Echoing Tolstoy's famous phrase that "all happy families are alike", there was less variability among Autonomy Promoting than among Autonomy Undermining play styles. Sometimes the Autonomy Undermining mother's affect communicated happiness and lightheartedness; this was particularly so for mothers who appeared to feel they should function as "teachers" during free play. Other Autonomy Undermining mothers appeared to act in a controlling manner out of a neurotic need to control and communicated more negative affect or exasperation with baby.

It is not surprising that this research found the relationships between maternal and infant variables because maternal play style subsumes dimensions of maternal behavior -- Accessibility vs. Ignoring, Cooperation vs. Interfering, Sensitivity vs. Insensitivity -- associated with infant attachment security and exploration (Ainsworth, et al., 1978). maternal play style also captures whether or not mother makes contingent responses. Obviously, Autonomy Promoting responses are contingent (e.g., appropriate in the context of baby's immediately preceding action) and Autonomy Undermining responses are non-contingent (unrelated to baby's action) or even anti-contingent (opposing baby's

action) (Seligman, 1991). Finally, maternal play style indicates whether mother's expectations are appropriate for baby's developmental level. Infant development in all domains is enhanced when parents are in synchrony with or slightly ahead of baby's level of competence. In Heckhausen's "one step ahead" concept (1987), parents enable baby's attainment of more advanced skills by actively joining in instrumental activities to move baby ahead. Trad's concept of "previewing" (1992) contains the idea that baby's development is enhanced when mother anticipates and actively supports the next advance (cognitive, motor, relational) baby is ready to make. The Autonomy Promoting mother tended to be in synchrony with or 'one-step-ahead' of baby, while observers noted that the Autonomy Undermining mother had great difficulty accepting baby's level of development. Often these mothers seemed to be ashamed of their babies, even though developmental delays were clearly not the issue!

This study employed free play as a projective device to encourage mothers to reveal their mode of interacting with baby. It was hoped that the free play situation would capture mother's typical interactive style with baby, e.g., the degree to which she supports her baby's autonomy on a day-to-day basis. As mentioned previously, the experimenter deliberately selected developmentally advanced toys for use in this study. Given the problem-solving demands of the

toys for one-year-olds, the question was how much mother would "take over".

The external validity of laboratory measures of maternal play style is supported by relationships identified in this study between maternal play style and infant exploration, both in response to the robot and in general approach orientation. The experimenter noted great consistency in mother-infant interaction from the moment subjects arrived to participate in the research until they left the laboratory. This consistency extended to the free-play episode, although maternal interactive style became particularly focused in the experimental situation, with its demand characteristics and inherent ambiguity. Anecdotal evidence also points to the likelihood that maternal interactive style was not merely situation-specific. A mother who participated in the study asked the experimenter to her apartment. During the research, the baby had behaved in a strikingly passive manner (pointing to toys and waiting for mother to perform the desired action), while mother had been quite controlling. The experimenter observed virtually identical interactions in the baby's home. Because the mother expressed frustration over the impasse she and her baby had reached, the experimenter seized the opportunity to model alternative behaviors for mother (e.g., saying to baby, "You can do it!" in a positive and motivating tone of voice). It was gratifying to hear mother repeating the

experimenter's words when she rejoined the experimenter and baby.

Mothers observed in this study ranged from primarily autonomy-undermining to highly autonomy-promoting vis-a-vis infant autonomy during free play. The percentage of Autonomy Promoting to total maternal interventions (AP + AU) ranged from 15% to 92%; the median Autonomy Promoting score was 51%. These percentages indicate that none of the mothers exhibited only Autonomy Promoting or Autonomy Undermining behaviors. Even a highly Autonomy Promoting mother occasionally behaved in a controlling manner toward baby. One of these mothers spontaneously remarked that she consciously fought her impulse to intrude on baby's play (as well as during their day-to-day interactions) because she felt it was very important for her baby to make his own choices whenever possible. Her infant impressed observers as particularly exploratory and self-directed. The finding that a few maternal Autonomy Undermining behaviors are inconsequential deserves emphasis. It is the proportion of Autonomy Undermining to Autonomy Promoting behaviors that is key; when the percentage of maternal interactive behaviors coded Autonomy Undermining reached 50% of total maternal interactions, babies began to exhibit greater dependence on mother.

Although maternal play style scores represent an accumulation of microbehaviors coded at 5-second intervals,

these scores corresponded with the overall, subjective impression mothers made on viewers as Autonomy Promoting or Autonomy Undermining. Each mother-infant interaction was unique, but mothers who could be described as primarily Autonomy Promoting or Autonomy Undermining had certain characteristics in common. In general, the Autonomy Promoting mother expressed respect for baby as a separate individual. She let baby initiate, lead and control play. She reinforced and supported baby's free exploration and pleasure in discovery. She adapted to baby's pace and goals. Her interactions with baby were sensitive and cooperative (Ainsworth, et al., 1978). Affective attunement with baby (Stern, 1985) was evident in frequent "oohs" and "aahs" when baby successfully popped up a Sesame Street character or dropped a block in the shape sorting toy (whether the lid was on or not!). Mother shared in but did not direct baby's discoveries with the toys. The coder gave mother an Autonomy Promoting score when she:

> Demonstrated/suggested strategy or pointed out characteristics of toy to baby, but waited for baby to complete action.
>
> Imitated/repeated/continued baby's action with toy.
>
> Picked up toy baby dropped and handed back to baby.
>
> Verbally or physically praised baby/expressed pleasure in baby's activity.
>
> Commented on baby's play/asked questions.

> Made toy baby was playing with or focusing on more accessible by repositioning it/bringing it closer/ preventing it from turning over.
>
> Echoed baby's vocalizations.
>
> Accepted toy baby handed her.

The author's notes taken while observing a mother who received a high Autonomy Promoting score indicate the subjective impression made by the Autonomy Promoting style:

> Mom communicates much involvement and interest in baby's play, but her posture is relaxed and she lets baby have his space -- no anxious "hovering" over baby.
>
> She consistently follows his line of interest -- she's really with him. She doesn't interfere -- when she comments on baby's play, it's in a subtle way. Allows him lots of freedom -- let's him choose what he wants to do next. He controls where they're going -- he leads. She really seems to enjoy baby as he is. A pleasure to watch them together.
>
> A lot of emotional attunement on mom's part. Affect mirroring: Oh! when he drops block in canister and bounces up and down. I would speculate that by saying Oh! in an emphatic and excited way when he accomplishes action, she shares in his impact on the world and reinforces his exploration.
>
> She lets him wander away from toys without dragging him back. Gently pulls him away from video camera. Greets him with affection when he returns.
>
> Doesn't try to change his level of play. Doesn't insist that he play with **all** the toys. Focuses him on object he expressed interest in -- builds on his initial curiosity to teach.

> Responds to his need for physical contact in a very natural, warm way. In general, lots of reciprocity and interdependence.

In contrast, the Autonomy Undermining mother tried to control baby's play. She tended to interrupt and interfere with baby's ongoing activity, redirecting baby's attention to another toy or abruptly demonstrating another mode of playing with the same toy. The Autonomy Undermining mother's interaction with her baby was often insensitive and interfering (Ainsworth, et al., 1978). She limited opportunities for baby to master challenges presented by the toys. She either modeled how to play with toys without baby's active participation or exerted physical control by guiding baby's hand with her own to manipulate the toys. When baby looked to her for help, the Autonomy Undermining mother typically would not encourage baby to persist or suggest strategies but would "do" for baby.

Interestingly, the primary coder commented that watching Autonomy Undermining mothers was stressful. She became angry at their insensitivity and wanted to tell them to "lay off" baby. However, Autonomy Undermining mothers seemed unaware of the impression their controlling behavior might make on observers. The coder gave mother an Autonomy Undermining score when she:

> Demonstrated how toy worked without baby's active participation.

> Accepted child's request that she perform action and did not encourage or wait for baby to perform action.
>
> Put hand on baby's hand, guided it to toy and performed action on toy.
>
> Redirected baby's attention to another toy or another feature of the same toy.
>
> Physically restrained baby from pursuing current acti- vity or verbally requested that baby stop.
>
> Interfered with baby's ongoing activity via physical affection.

The author's notes taken while observing a mother who received a low Autonomy Promoting score indicate the subjective impression made by the Autonomy Undermining style:

> When mom places her hand over baby's, it's hard to tell who actually made the block drop through the shape sorter into the canister.
>
> She doesn't seem to relate to him well ... talks to him like an adult.
>
> Very concerned with her own interests -- not paying attention to what baby wants -- even struggles with baby to control toy!
>
> Communicates disappointment with baby's toy selection: "Oh, you keep going back to Ernie, don't you?!"
>
> She's praising baby for doing something which she directed baby to do. An Autonomy Undermining followed by an Autonomy Promoting behavior. That's confusing! (To baby, too?)
>
> She appears to be captive to her expectations of how baby "should" play. It's sad -- she seems to be ashamed that baby doesn't play like a two-year-old.

> The play doesn't seem spontaneous on mom's part. She doesn't "go" with baby. Tries to impose her own structure.

A further observation regarding maternal behavior in the present study is warranted. The original definition of the Non-Participating dimension of maternal play style included both "ignoring" and "observing only" on mother's part. However, because so few mothers ignored their babies at any point during the free-play episode, the ignoring component was dropped from the definition and Non-Participating became equivalent to "observing only".

Maternal observing was not statistically related to infant behaviors assessed in the study. This finding is consistent with Grolnick, et al.'s (1984) research in which maternal task-directed behaviors appeared to have the most direct relationship with infant behavior. However, over the course of the research, it became evident that the experimenter's original definition of "observing only" ("passively observes infant play") was misguided. The concept of maternal observing as passive sprang from the experimenter's belief that mother should be actively involved in play most of the time. However, maternal observation of baby's play in this study was anything but passive. Mother's "style" of observing ranged from relaxed and "quietly available" at a comfortable distance from baby to hovering anxiously over baby. In either case, mother was intently focused on baby's activities and could hardly be

characterized as "passive". It appeared that relaxed, "quietly available" observing on mother's part is potentially autonomy supportive. Clearly, mother can encourage baby's spontaneous play by being available when baby needs her but letting baby pursue her or his own goals in the meantime. Some mothers exhibited a combination of Autonomy Promoting behaviors and quiet observation which appeared to be particularly effective. These dyads were characterized by a calmness which communicated itself to observers and an sense of intention and purpose on the part of baby which seemed ideal.

Infant Exploration and Infant Temperament

The study confirmed that mothers rated babies who explored more confidently in the laboratory as approach oriented in general on the temperament scale. Apart from the question of whether temperament mediated infant behavior in the laboratory, this finding supports the external validity of the robot episode. At the very least, babies' behavior in the laboratory corresponded with their behavior in the outside world. High frequency referencers and infants who avoided the robot scored higher on temperament questionnaire items such as:

> "Baby cries, clings to mom/dad when new babysitter comes to house."
>
> "For the first few minutes in a new place, baby clings to mom."
>
> "Baby turns away/clings to mom or dad on meeting another child for the first time."

> "Baby is afraid of being put down in an unfamiliar place when mom or dad are there.

Low frequency referencers and infants who approached the robot scored higher on temperament questionnaire items such as:

> "Baby reacts positively to seeing doctor."
>
> "Baby goes up to and tries to play with unfamiliar pets."
>
> "Baby smiles when approached by unfamiliar adults.
>
> "Baby approaches visitors at home."

The research design originally proposed temperament as an alternative explanation to maternal interactive style to account for infant exploratory differences identified in the pilot study. However, infant exploratory confidence (referencing frequency and robot approach/avoidance) in the laboratory correlated significantly with both maternal play style and maternal ratings of infant approach temperament. This finding is further complicated the identification of a highly significant correlation between maternal ratings of infant temperament and maternal play style. Autonomy Promoting mothers rated their babies as more approach oriented in general toward novel situations and people; babies' behavior toward the robot reflected maternal evaluations of babies' general approach orientation. Is a direction of effects (Bell, 1968) issue implicit in these results? Does maternal interactive style influence infant TA characteristics? There is research indicating that

maternal personality variables predict certain dimensions of infant temperament (Mangelsdorf, et al., 1990). Alternatively, do babies who are more approach oriented elicit Autonomy Promoting behavior from mother? If baby is primarily responsible for maternal play style, this would imply that mothers respond to and reinforce approach-oriented babies with independence-promoting behaviors. They would respond to less confident babies in a more controlling and intrusive manner. The mother of a timid baby might tend to compensate by "doing more" for baby, perhaps reinforcing baby's tendency to withdraw from unfamiliar stimuli. However, this latter combination (of timid baby and dominating mother) would not be adaptive on mother's part or facilitative of infant development.

This study cannot resolve the issue of whether infant temperament elicits maternal play style or whether maternal play style reinforces temperament or whether the temperament questionnaire is tapping into biologically-based characteristics which may be modified by certain patterns of mother-infant interaction. It is clear that the Toddler Temperament Questionnaire items cited above do not necessarily measure biologically-based traits. Certainly a temperament questionnaire administered in later infancy cannot factor out the relative contributions of biology and parent-infant interaction over baby's first year of life. Ultimately the question of direction of influence makes a

conceptually necessary but artificial distinction. Winnicott's poetic images of the interdependence of mother and baby reflects the reality that mutual influences are inevitable and desirable in the mother-infant relationship. Infants and parents continuously monitor, influence and determine each other's behavior and meaning to one another (Seligman, 1991). Rather than trying to resolve the nature/nurture question, it is more useful to identify interactions which promote infant self-determination and exploratory confidence. Because it is the parent who can consciously alter behavior, it is the adult's interactive style which may be modified to enhance the dyad (Trad, 1992).

Infant Exploration and Infant Cognitive Development

This research did not find a relationship between cognitive maturity and infant exploratory differences. When confronted with the robot, some babies appeared to take mother for granted as a resource for support and did not need her direct reassurance. However, these more readily exploratory babies were not more cognitively advanced than babies who referenced persistently and avoided the robot. The finding that the range of infant differences identified in the pilot study correlated with maternal play style and maternal ratings of infant approach temperament but not with infant cognitive development (level of object permanence)

supports the notion that social referencing is a socioemotional variable.

The lack of correspondence between emotional security and cognitive sophistication raises several issues: (1) temperament and/or maternal play style may affect baby's emotional ability to explore but not cognitive development and (2) the dissonance between emotional and cognitive development may be problematic for some babies. For example, the baby who scored highest on the object permanence task (also one of the babies who figured out how to manipulate the dinosaur using the wire control) had a very Autonomy Undermining mother. He was very distressed when the robot appeared and went directly to mother. However, when he was seated on mother's lap for the object permanence task, he was able to focus extremely well and follow each hiding sequence presented by the experimenter.

The validity of the measure of object permanence used in this study might be questioned (although it did correlate with infant age in weeks). In order to be scored for best performance, a baby needed to relate to the examiner as well as attend fully to each hiding sequence. Although the examiner attempted to motivate babies to participate and carefully monitored their attention to the hiding sequences, five out of 26 babies could not be scored. These five were either too distracted or too "cranky" to participate in the testing. Emotional/attentional factors clearly are

important determinants of infant performance on this cognitive measure. The experimenter enjoyed administering the object permanence tasks, but the value of this component of the research is unclear.

Conclusion

As discussed above, this is not the first study to attempt to relate social referencing to other variables. However, other studies have had little success relating social referencing to global constructs, such as security of attachment. The successful identification of referencing-related variables in the present study may be due to the choice of variables (maternal play style, a single dimension of infant temperament) which correspond in level of measurement with the items of infant behavior assessed in the uncertain situation (looking to mother, approaching/avoiding the robot).

Most importantly, this research once again highlights the importance of "maternal control style" (Grolnick, Frodi & Bridges, 1984, 1985), which has been linked both with infant persistence at challenging tasks (mastery motivation) and stability of attachment. Given the developmental significance of play during early childhood and the emotional significance to baby of parents as play partners, it is crucial that baby be given free reign in play situations. After all, one-year-olds can exercise free will and experience self-determination most immediately and

safely during play. Winnicott (1971) points out that the young child's preoccupation with play must be respected and protected. The specific content of play or the objects played with are irrelevant:

> "it not the cloth or the teddy bear that the baby uses ... [but] the use of the object ... what matters is the near-withdrawal state, akin to the concentration of older children and adults" (pp. xi, 51)

This study indicates that an intrusive parental play partner not only limits baby's opportunities to experience pleasure at mastering a challenging toy but in a broader sense hinders baby's concentration on manipulating play materials and absorption in play. Because the young child can safely experiment with aggression by acting on objects during play (Winnicott, 1971), the controlling parent may also prevent the healthy working through of aggressive impulses.

Two additional points should be noted. First, the researcher was struck by the general lack of knowledge about early child development among this high SES, relatively well-educated sample of mothers. The more Autonomy Promoting mothers were likely to comment to the researcher that they wished they knew more about age-related developmental milestones but they nevertheless appeared comfortable with whatever their babies were inclined to do. In contrast, the more Autonomy Undermining mothers appeared to have developmental expectations inappropriate for baby's age. They demonstrated frustration with babies' approach to

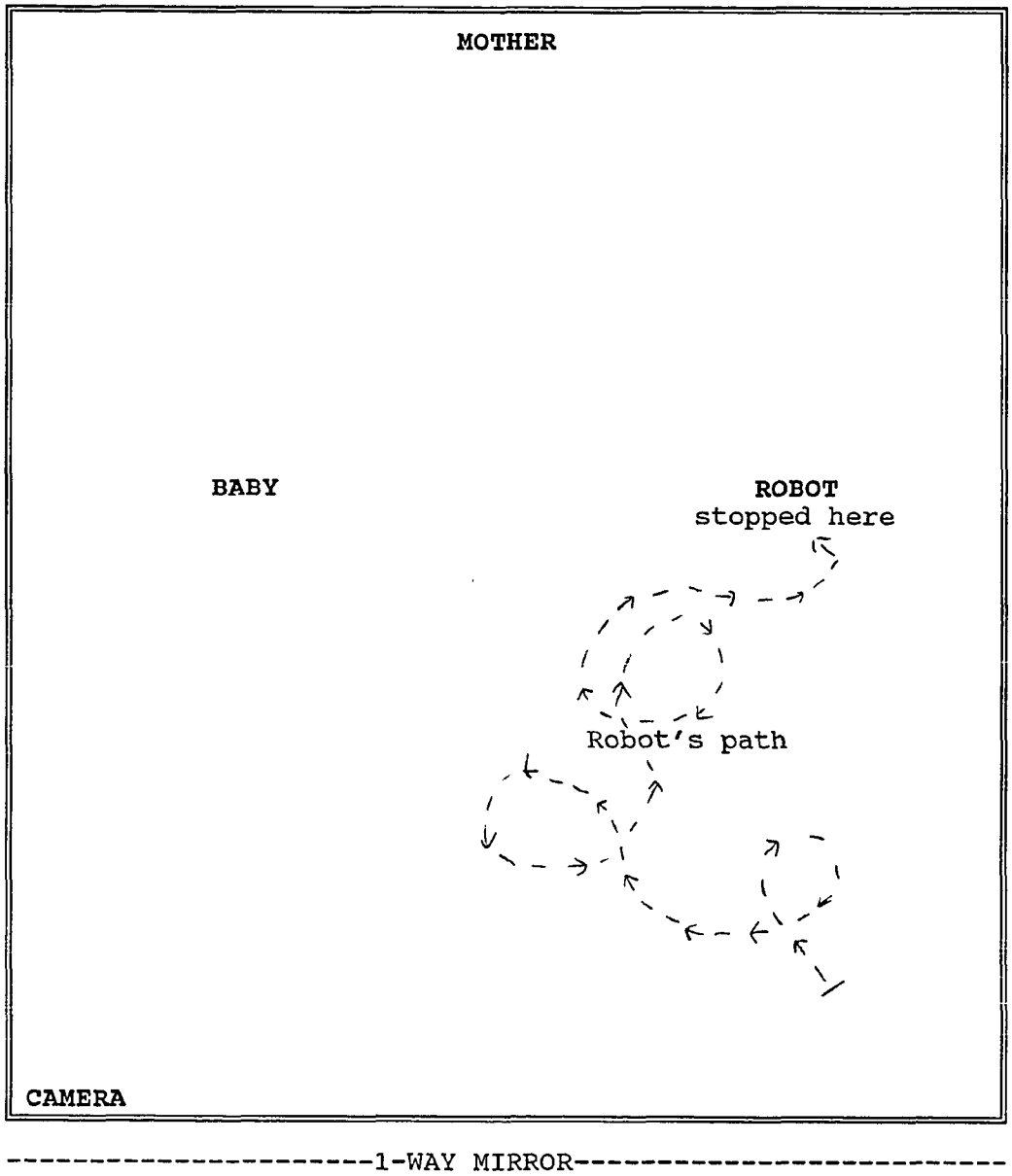
toys during free play and apologized to the researcher that their babies did not adopt the most advanced toy play strategies. The more Autonomy Undermining mothers also appeared to view active teaching as necessary for baby's cognitive development. They appeared not to understand that, given the appropriate stimulation and emotional support, infants' abilities unfold naturally.

Second, although it was exciting for the researcher to obtain results supporting her hypotheses, each mother-infant pair's interaction had its own "personality" which probably could only be captured with the most complex coding system imaginable. The coding approach used in this study successfully identified a dimension of maternal behavior which is related to infant exploration, but at the cost of simplifying very complex and dynamic mother-infant interactions.

Finally, the exploratory behavior of two babies completely contradicted the research hypotheses. This prompted the researcher to examine in great detail mother-infant free play and temperament ratings for these two cases. However, even this detailed analysis failed to yield useful clues. The fact that the hypotheses could not account for all babies observed in the study presents a challenge to infancy researchers. The human personality remains essentially mysterious, even in the smallest and youngest among us.

FIGURE 1

DIAGRAM OF EXPERIMENTAL ROOM



APPENDIX A

MEASUREMENT OF MATERNAL INTERACTIVE STYLE

Three categories of maternal style were coded from the videotapes of mother-infant free play. At each 5-second marker of the 15-minute play episode, mothers were scored on one of the three categories (Non-participating, Autonomy-Promoting and Autonomy-Undermining) described below.[1] Scoring mothers' behavior twelve times during each of the fifteen free-play minutes resulted in a maximum of 180 intervals scored per mother.[2] Examples given below for each of the three categories were used to determine which category described the mother's behavior at each 5-second interval; they were not coded separately.

Computation of Scores

Two overall scores were computed from the 180 category scores recorded for each mother:

---

[1] Piloting indicated that coding the mother's behavior at each 5-second marker rather than within each 5-second interval eliminated the problem of how to deal with more than one category of behavior occurring during an interval.

[2] Not every interval received a score. For example, if baby temporarily lost interest in the toys, mother was not scored Autonomy-Undermining for attempting to redirect baby's attention. (While some mothers easily tolerated their baby's interest in other facets of the experimental space, most appeared to feel that the experimenter had asked them to keep baby focused on the toys and acted accordingly.)

(1) a Non-Participating (NP) score: The number of intervals scored NP divided by the total number of intervals scored (T): NP / T

(2) an Autonomy-Promoting (AP) score: The number of times the mother's behavior was scored AP divided by the sum of the frequencies she received for AP and Autonomy-Undermining behaviors: AP / (AP + AU). Thus, the AP score reflects the proportion of mother's active play interventions which were autonomy promoting.

The three behavioral categories coded were as follows:

I. A. **Non-participating:** Mother is involved in an activity which does not involve baby and is not attending to baby.

Mother...

Attends to object other than baby.

Plays with toy by herself while baby attends to another object.

I. B. **Observing**

Mother watches baby play but does not talk to or actively participate in baby's play. In the original definition of Observing was the phrase "passively observes baby's play".

II. **Autonomy Promoting:** Mother waits for baby to initiate, control and direct play. Her participation consists of demonstrating positive emotional involvement in baby's play

through expressing interest and voicing pleasure at baby's successes. She may join in infant-initiated toy play but baby determines which toys they will attend to and when. Mother provides cues which help baby to develop strategies and motor skills, but she does not "do" for baby.

Mother...

Demonstrates/suggests strategy or points out characteristics of toy but does not complete action.

She waits for baby to complete action.

Imitates/repeats/continues baby's action with toy.

Picks up toy baby drops and hands back to baby.

Verbally praises baby/expresses pleasure in baby's activity.

Physically praises baby/expresses pleasure in baby's activity.

Comments on baby's play/asks questions.

Makes toy baby is currently playing with or focusing on more accessible: repositions/brings closer/prevents from turning over.

Echoes baby's vocalizations.

Takes toy or object baby hands to her.

III. **Autonomy Undermining:** Mother controls and directs baby's play or tries to influence which toys baby plays with and how he/she plays with toys. She performs actions on toys for baby instead of waiting for baby to attempt these actions or initiate its own approach to toys.

Mother...

Demonstrates how toy works without baby's active participation.

Accepts child's request that she perform action. Does not encourage or wait for baby to perform action.

Puts hand on baby's hand, guides it to toy and performs action on toy.

Redirects baby's attention to another feature of the same toy.

Redirects baby's attention to another toy.

Physically restrains baby from pursuing current activity or verbally requests that baby stop.

FREE-PLAY CODING SHEET

0 = Can't code interval

1 = **Non-participating**

Attends to object other than baby.

Plays with toy by herself while baby attends to another object.

4 = **Observing only**

2 = **Autonomy-Promoting**

Demonstrates/suggests strategy or points out characteristics of toy but does not complete action. She waits for baby to complete action.

Imitates/repeats/continues baby's action with toy.

Picks up toy baby drops and hands back to baby.

Verbally praises baby/expresses pleasure in baby's activity.

Physically praises baby/expresses pleasure in baby's activity.

Comments on baby's play/asks questions.

Makes toy baby is currently playing with or focusing on more accessible: repositions/brings closer/prevents from turning over.

Echoes baby's vocalizations.

Accepts toy or object baby hands to her.

3 = **Autonomy-Undermining**

Demonstrates how toy works without baby's active participation.

Accepts child's request that she perform action. Does not encourage or wait for baby to perform action.

Puts hand on baby's hand, guides it to toy and performs action on toy.

Redirects baby's attention to another toy or facet of same toy.

Physically restrains baby from pursuing current activity or verbally requests that baby stop.

Interferes with baby's ongoing activity via physical affection.

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