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Developmental Changes in Infants' Knowledge of the Instrumental Value of Babbling

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Abstract

The present study sought to discover the age at which infants realize that their vocalizations may be used to elicit social responses from others, and to examine whether infants' knowledge of the consequences of their babbling is related to their primary caregivers' natural levels of responsiveness. Participants were 27 caregiver-infant dyads from the Ithaca, NY area. Infants were 2 and 5 months of age. Infants participated in an unstructured play session with their caregivers, followed by a still-face interaction with an unfamiliar experimenter who initially engaged the infants, and then became quiet and assumed a neutral expression. Five-month-olds exhibited a significant increase in the quantity of non-cry vocalizations from the first interaction period to the still-face, thus demonstrating that they have learned that their vocalizations have an effect on others. Two-month-olds did not show a significant change in the quantity of vocalizations. No significant relationship was found between caregiver responsiveness and infants' vocal behavior across the still face.

Developmental Changes in Infants' Knowledge of the Instrumental Value of Babbling

Numerous studies have shown that infants are capable of perceiving associations between their actions and a resulting environmental consequence (Alessandri, Sullivan, & Lewis, 1990; Fagen & Ohr, 1985; Lewis, Sullivan, & Brooks-Gunn, 1985; Watson, 1972; Rovee & Rovee, 1969). The ability to detect contingency- the presence of a temporal relationship between the occurrence of two events- is present from a young age (Moran, Dumas, & Symons, 1992). Findings have provided evidence that infants as young as 2 months old can distinguish between contingent and non-contingent social interactions with their mothers (Stormark & Braarud, 2004). Given young infants' sensitivity to social contingency and the fact that, within mother-infant interactions, their vocalizations are quickly and reliably followed up by maternal responses (Hsu & Fogel, 2003; Gros-Louis, West, Goldstein, & King, 2006), infants should learn that their babbling has social consequences (Goldstein, Bornstein, Schwade, Baldwin, & Brandstadter, submitted). At what age does this communicative understanding emerge?

The present study was developed to discover the age at which infants realize that their non-cry vocalizations have an effect on others, and to explore whether individual differences in the ability to do so are related to differences in caregivers' responses to babbling. In doing so, I examined whether 2-month-old infants have learned that their vocalizations get social reactions from others. The study was based on a basic premise of operant learning which states that when an acquired association between a behavior and an outcome is extinguished, a characteristic change in the subject's response rate occurs. This change, known as the extinction effect, is typically identified as a transitory increase in the learned behavior, followed by a lasting decrease (e.g. Skinner, 1938).

The extinction effect has been observed in both humans and other animals following the violation of an observed contingency between a paired behavior and its related outcome (Warren & Brown, 1943; Skinner, 1938). Skinner (1938) found that rats that had detected a contingency between bar-pressing and a food reward exhibited a transitory increase in lever-press responses when the action was no longer paired with food. In an adapted version of this study designed for use with humans, young children learned a contingency between pressing a lever and receiving candy (Warren & Brown, 1943). When the contingency was suddenly violated, the children pressed the bar an increased number of times in an attempt to get more candy, and then eventually gave up.

A specific type of extinction effect, known as the partial reinforcement extinction effect, is particularly apt for the present study because it provides a model of what happens when learning that occurs under imperfect contingencies is extinguished (Amsel, 1958, 1962; Festinger, 1961). Learning under imperfect contingencies is considered to be "partially reinforced" because the designated behavior is only reinforced, or paired with its associated outcome, *some* of the time. This is the case for infant prelinguistic vocalizations as it has been found that mothers typically only respond to them about 50% of the time (Bornstein & Tamis-LeMonda, 1989; Green & Gustafson, 1997). Partial reinforcement schedules such as this are associated with more gradual learning curves because it generally takes longer to learn the association between a behavior and an outcome that are only paired together occasionally, as compared to a behavior and an outcome that always co-occur with one another (e.g. Millar, 1972).

In their 1990 study, Alessandri, Sullivan, and Lewis investigated whether young infants, like older children, would produce an extinction response when a detected contingency was

extinguished. Infants aged 2 to 8 months were presented with an audiovisual stimulus contingent on their arm movements. After infants demonstrated that they had learned the contingency by increasing their rate of arm-pulling compared to baseline, the stimulus was no longer paired with the arm movement. Results showed a fourfold increase in rate of arm-pulling during extinction in infants of all ages compared to baseline. These results support the idea that young infants are able to detect behavior-based contingencies and show an extinction response when such contingencies are violated.

Behavior-based contingencies, or associative learning that involves an infant's behavior as the first event in a contingency and an external event as the second one, are of particular significance in infants' social interactions because they concern infants' abilities to detect contingencies that are dependent on their actions (Tarabulsy, Tessier, & Kappas, 1996). Many behavior-based contingencies occur naturally, within caregiver-infant play. One example of a naturally occurring behavior-based contingency is a caregiver responding to an infant's vocalization. Once infants learn that vocalizing receives a social response, they may use their vocalizations to influence their caregivers or other social partners. Tarabulsy and colleagues concluded that recognizing the contiguity between one's actions and the resulting environmental consequences can help individuals to predict and influence future events (Tarabulsy et al., 2003). Once infants realize that their babbles can elicit reactions from others, they can employ them in interpersonal interactions to garner desirable responses from their social partners. This study was designed to find out the age infants learn about the social outcome of their babbling. To do so, it explored the extinction effect as it pertains to infant prelinguistic non-cry vocalizations. The design utilized the still-face paradigm to control experimenter behavior during face-to-face

interactions between an experimenter and an infant (Tronick, Als, Adamson, Wise, & Brazelton, 1978).

History of the Still Face Procedure

The Still Face Procedure (SFP) has been used extensively to examine infants' emotional regulation and reactions to violated contingencies. It consists of three phases of face-to-face interaction between infants and either their caregivers or an experimenter (Tarabulsy et al., 2003). During the first phase (Play1), the caregiver or the experimenter is asked to engage the infant in a playful face-to-face interaction. Next, during the second phase (Still Face), the adult is asked to assume an expressionless face while looking at the child, but refraining from responding to any of the baby's signals. Finally, during the third phase (Play 2), the adult resumes playful interaction with the baby. Although the length of the phases may vary, the two interaction periods generally last for one minute each, whereas the still-face is typically 2 minutes in length (Adamson & Frick, 2003).

Although the procedure typically lasts only a few minutes, it has become central to infant research over the past twenty years due to its ability to assess multiple infant response measures (Cohn, 2003; Muir & Lee, 2003). Having initially originated as a way to test the hypothesis that infants are active participants in mutually-regulated social interactions (Tronick et al., 1978; Adamson & Frick, 2003) the SFP has since been adapted to explore such wide-ranging research interests as gender differences in early communication (Weinberg, Tronick, Cohn, & Olson, 1999), the effects of autism on social expectancies (Nadel, Croue, Mattlinger, Canet, Hudelot, Lecuyer, & Martini, 2000), and how maternal depression contributes to an infant's response to the removal of social contingencies (Moore, Cohn, & Campbell, 2001).

Nevertheless, the majority of still-face studies have focused on emotional aspects of infants' responses to their social partners' disengagement. Specifically, researchers have used the paradigm to study emotional regulation in terms of the behaviors that infants exhibit when they are confronted with a social partner who is suddenly unresponsive. The standard infant emotional response to the scenario is known as the Still-Face Effect (SFE) (Gusella, Muir, & Tronick, 1988). The SFE generally follows an observable pattern: at the onset of the still-face, the infant first exhibits positive, interactive behaviors such as smiling and vocalizing. When this fails to elicit a response from the social partner, the infant smiles less, shows an increase in gaze aversion (looks away from the adult), and may even fuss or cry (Tarabulsy et al., 2003). Decreases in smiling and visual attention to the adult's face have been observed in infants ranging in age from 1.5 to 9 months old (Bertin & Striano, 2006; Striano, 2004).

What causes the still face effect? Researchers describe the SFE as an attempt by infants to re-establish a reciprocal interaction with their social partners, and a subsequent response to their inability to do so (Tarabulsy et al., 2003). In this view, infants react to the adult's unresponsiveness and lack of expression because such behaviors violate their expectations for social interactions (Carter, Mayes, & Pajer, 1990). A number of studies suggest that infants expect their social partners to remain responsive and to reciprocate in face-to-face interactions (Ellsworth, Muir, & Hains, 1993; Muir & Hains, 1993; Rochat & Striano, 1999). While infants aged 1.5 months show the Still-Face Effect, newborns do not, suggesting that social experience may be necessary to construct the infants' social expectations that are violated in the paradigm (Bertin & Striano, 2006; Striano, 2001).

Cleveland and others found that infants in the SFP are primarily affected by the loss of contingency between their behaviors and their social partner's response (Cleveland, Kobiella, &

Striano, 2006). Social expectancies are thus rooted in contingency perception. Opportunities for infants to perceive contingencies (specifically behavior-based ones) are readily available within the context of mother-infant interactions, as infant vocalizations are often quickly and reliably followed up by maternal responses (Beebe, Jaffe, Feldstein, Mays, & Alson, 1985; Hsu & Fogel, 2003; Gros-Louis et al., 2006).

As behavior-based contingencies play a prominent role in social interactions, it is unsurprising that infants change their behavior when contingencies are violated. Reactions such as the SFE and the extinction response indicate that infants organize their behaviors around expectations that they build from experiences and interactions with the environment around them (Tarabulsy, Tessier, & Kappas, 1996). The SFP thus presents a test of what happens when interactive contingency is violated and environmental consequences (e.g. social partner's behavior) are no longer available (Tarabulsy et al., 1996).

Infant Vocalizations Within Still Face Interactions

Although the SFP has been used extensively to study infants' responses to the loss of social contingency, as well as emotional self-regulation, the majority of studies using the procedure have excluded infant non-cry vocalizations, which are part of an important behavior-based contingency commonly found in infant social interactions. Two still-face studies included prelinguistic vocalizations with the IRSS (Infant Regulatory Scoring System) vocal categories of positive/neutral, fusses, and crying (Weinberg & Tronick, 1994, 1996). The data was expressed in terms of the number of infants who exhibited each type of vocalization. Thus, due to a lack of within-subjects analyses, no conclusions could be made about changes in quantity of infant vocalizations during the still face paradigm.

Within-subjects analyses are needed to draw conclusions about infants' knowledge of the instrumental value of their babbling. Of the relatively few studies that have examined infant non-cry vocalizations within the context of still face interactions, even fewer have included such within-subjects analyses. In fact, to the best of my knowledge, only two such studies exist. The first, conducted in 2002, found that 6 month old infants significantly increased their babbling during the still face phase of a face-to-face interaction with their caregiver (Delgado, Messinger, & Yale, 2002). The described study, however, did not go into much detail as to why this was the case, as its purpose was actually to examine infants' responses to their caregivers' direction of eye gaze during the still face.

The second study (Goldstein et al., submitted), found that younger infants- namely, 5-month-olds- exhibited a vocal extinction effect during the still-face phase of an interaction with an unfamiliar female experimenter. This effect was represented by a statistically significant increase in the quantity of non-cry vocalizations during the still face period, followed by a statistically significant decrease. Figure 1 illustrates the described vocal extinction effect in Goldstein et al. (submitted).

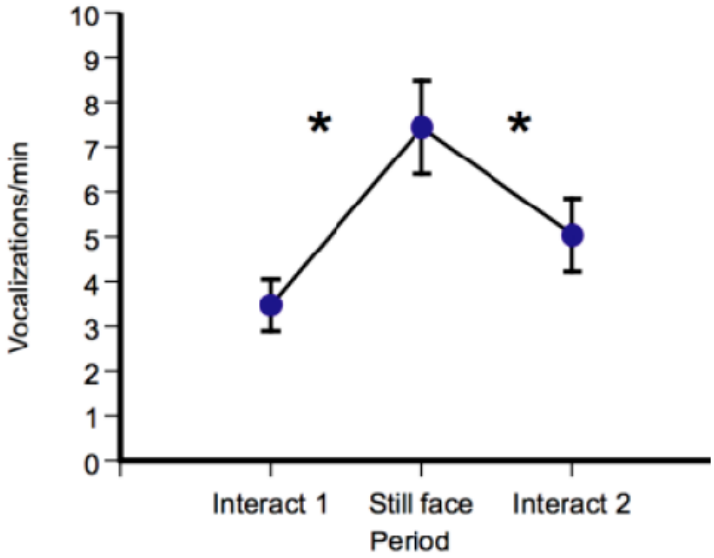

Figure excerpted from: Goldstein, M. H., Bornstein, M.H., Schwade, J. A., Baldwin, F. & Brandstadter, R. (2007, March). Five-month-old infants have learned the value of babbling. Poster presented at the Biennial Meeting of the Society for Research in Child Development, Boston, MA.

These data establish that 5-month-old infants have learned that their own vocalizations obtain social responses from others. Infants unaware of this contingency would not have exhibited an increase in vocalizing after their social partner ceased to respond. The findings are comparable to the extinction response in infants who, having detected a contingency between their foot-kicking and a mobile moving, increase their rate of kicking when they find the spinning of the mobile is no longer contingent upon their foot movements (Rovee & Rovee, 1969).

In addition to measuring the amount of non-cry vocalizations that infants exhibited during each phase of the still face, the study also measured smiling as a control behavior, as it has been found to be linked to affective state (e.g. Messinger, 2005). After conducting correlational analyses, the researchers did not find a relationship between vocalizing and smiling across any of the phases of the still face interaction. Rather, they found that the behaviors were independent of one another. Thus, although prelinguistic vocalizations have been considered by some to be an indicator of infants' affective state, Goldstein et al.'s findings indicate that babbling is dissociated from affect, and is instead a product of infants' past social interactions.

Purpose of the Present Investigation

The present study was designed as a follow-up to Goldstein et al.'s study of 5-month-olds' vocal reactions to the still face. As described above, Goldstein found that 5-month-old infants exhibited a vocal extinction effect when the female experimenter with whom they had previously been interacting assumed a still face and became unresponsive. The present study employed the same procedure, again with 5-month-old infants, to replicate the described results.

In addition, the present study expanded on the previous research by testing 2-month-old infants to see if they too would exhibit a vocal extinction effect when their social partner became unresponsive. In order to address this question, I tested the following two competing hypotheses: 1) by the time they are 2- months-old, infants have learned that their babbling causes changes in others' behavior, and 2) 2- month-old infants have not yet learned that their babbling has an effect on others.

The first hypothesis is supported by previous studies that have shown that 2-month-old infants are capable of detecting behavior-based contingencies, and that they exhibit extinction effects when such contingencies are violated (e.g. Alessandri, Sullivan, & Lewis, 1990). Given this, it is possible that they may have detected the contingency between their own vocalizations and their caregivers' responses. If 2-month-old infants have detected this contingency, then like 5-month-olds, they would be expected to exhibit a vocal extinction effect when the social partner with whom they have been interacting suddenly becomes unresponsive.

On the other hand, the second hypothesis, that 2-month-olds have not yet learned that their babbling causes changes in others' behavior, is supported by data from a previous study that found that adults rate infants who produce more fully-voiced vocalizations as being more capable of intentional communication (Beaumont & Bloom, 1993). Given that 2-month-olds,

unlike 5-month-olds, are not yet capable of making such fully-voiced vocalizations, it is possible that adults may not be as responsive to 2-month-olds' vocalizations because they do not consider the vocalizations as having very much communicative value (Oller & Lynch, 1992).

Indeed, it has been found that caregivers' responses to infant behaviors vary as a function of infant vocal repertoire size (Goldstein & West, 1999). Specifically, in a study which employed a playback paradigm to assess the influence of infant auditory and visual cues on adult behavior, it was found that as the size of infant vocal repertoire increases, mothers become increasingly reliant on auditory cues to guide their behavior when responding to infants. Importantly, however, whereas mothers' responses to infants with medium-to-large vocal repertoires are guided by infant vocalizations, their responses to infants with small vocal repertoires (such as those characteristic of 2-month-olds) are guided more by visual cues of what the infants are doing, rather than by the sounds that the infants make. Given this developmental change in caregiver responsiveness to infant behaviors, it may be the case that 2-month-old infants have not yet learned that their babbling has instrumental value because their vocalizations may not be responded to as frequently as those of older infants who are capable of making more mature, speech-like vocalizations.

In order to test infants' knowledge regarding the influence that their babbles can have on others, the primary aim of the current study was thus to examine whether infants changed their babbling when their social partner assumed a neutral expression during the still-face phase. If infants are aware that their vocalizations elicit social responses from others, then they should show a significant increase in babbling from Play 1 to Still Face, followed by a significant decrease in babbling from Still Face to Play 2. Alternatively, if they are not aware of the relationship between their vocalizations and others' social responses, then they should not

exhibit a change in amount of vocalizations during the still face, as compared to the other interaction periods.

By testing both 2-and 5-month-old infants, my aim was to explore the onset of the vocal extinction effect to discover the age at which infants realize that their babbles have an effect on others. After infants recognize that their vocalizations can be used to get social responses from others, they have more opportunities to interact with and learn from their parents. Establishing an age at which this understanding emerges could help to predict communicative delays at an early age.

In addition to assessing infants' knowledge of the instrumental value of their babbling, a secondary aim of the present study was to examine infants' smiling behavior through out the still face interaction to see if it was in any way related to their vocalizing through out the same interaction. Given Goldstein et al.'s (submitted) finding that vocalizing and smiling are independent from one another, I expected to find dissociations between the two behaviors through out the still face interaction. The described finding would provide further evidence to suggest that babbling is not an indicator of affective state, as has been thought by some scholars.

Finally, a third objective of the present study was to assess whether infants' knowledge of the instrumental value of their babbling is related to their caregivers' level of responsiveness. Numerous studies have documented a relationship between maternal responsiveness and children's early language achievements (e.g. Tamis-LeMonda, Bornstein, & Baumwell, 2001; Tamis-LeMonda, Bornstein, Baumwell, & Damast, 1996; Landry, Smith, Miller-Loncar, & Swank, 1997). The majority of these studies have examined the relationship between caregiver responsiveness and infant language development during the latter half of the first or through out the second year of life. It is, however, known that infants as young as 2-months-old are sensitive

to their caregivers' levels of social contingency (Bigelow & Rochat, 2006). Given that infants are sensitive to their caregivers' contingency, the present study sought to find evidence to support the idea that caregiver responsiveness during the first half of the first year of life (namely, when infants are 2 and 5 months of age) is related to infants' communicative development.

Therefore, in addition to the SFP, infants in this study also participated in a naturalistic, free-play session with their caregivers. The purpose of the play session was to get a baseline measure of caregivers' natural levels of responsiveness to their infants' prelinguistic vocalizations and other interactive behaviors. Data from the SFP and the play session were then compared to test whether the presence of vocal extinction effects was related to differences in caregivers' responses to their prelinguistic infants. I hypothesized that infants of highly responsive caregivers would exhibit a strong vocal extinction effect during the still face phase because they should have already learned the contingency between their vocalizations and their caregivers' responses. These findings would provide evidence to suggest that high levels of caregiver responsiveness facilitate communicative development.

Method

Participants

Participants were 27 caregiver-infant dyads from the Ithaca, NY area. They were recruited from recent birth announcements in the Ithaca Journal. Fifteen 2-month-olds (6 males, 9 females, M= 2 mos., 7 days, Range= 1 mo., 28 days - 2 mos., 15 days) and twelve 5-months-olds (6 males, 6 females, M= 5 mos., 7 days, Range= 4 mos., 26 days to 5 mos., 15 days) participated. The data from an additional 20 caregiver-infant dyads could not be used for the study. Six of these dyads included 2-month-olds and the remaining 14 included 5-month-olds. One 2-month-old was excluded for falling asleep during the procedure, whereas one 5-month-old

was excluded because her father distracted her during the still face. The remaining 18 infants were excluded from analysis due to extreme fussiness or crying. Additionally, 5 caregiver-infant dyads that were included for still face analyses were excluded from analyses of caregiver responsiveness because their play sessions were in a language other than English, and therefore could not be coded.

Materials and Apparatus.

The study took place in a 5.4 x 3.6 m playroom containing a stationary infant seat and a bin of infant toys. For the ten-minute play session, caregivers were free to move about the room with their infants and to play with the toys as they chose. During this time, their behavior was recorded using three wall-mounted cameras (Handycam TR-100, Sony, Tokyo) which were routed to a digital tape deck (DV 2000) via a video mixer (Videonics MX Pro DV). Infant vocalizations were recorded with a wireless microphone that was concealed on the upper chest of a pair of baby overalls that the infants wore for the duration of the study. All infant vocalizations were thus picked up by the microphone and then routed to the left stereo channel of the video tape recorder via an audio mixer. Caregivers' and the experimenters' sounds were also recorded by a microphone that they clipped onto their clothing. The experimenter who interacted with infants during the still face interaction wore a pair of wireless headphones over which she was instructed by an observer about when to begin each phase of the interaction. The observer's instructions were recorded with a head-worn microphone and routed by the mixer to both the experimenter's wireless headphones, and the right stereo channel of the video tape recorder.

Experimental Design and Procedure.

The study began with a ten-minute naturalistic caregiver-infant play session in a playroom containing a bin of infant toys. Caregivers were asked to play with their infants as they

would at home. Caregiver and infant vocalizations were recorded in order to assess vocal contingency. Both caregiver and infant behavior was recorded by three wall-mounted video cameras.

After the free play session, infants participated in a 4-minute still face procedure with an experimenter (as in Bornstein, Arterberry, & Mash, 2004). Each of the two interaction periods lasted for a minute, whereas the still-face lasted for 2 minutes. During this time, caregivers sat in a chair just behind the infants, but out of their view. As their infants participated in the still face interaction, caregivers filled out the Infant Behavior Questionnaire to assess their infants' temperament (Gartstein & Rothbart, 2003), and then a separate questionnaire to gather background and demographic information (see Appendix).

For the duration of the still face procedure, infants were placed in a stationary infant seat at eye level with the experimenter. The experimenter wore wireless headphones over which she was instructed to "Play," "Assume the still face," or "Resume play," at the beginning of each phase. Once the infant was in an alert state, the experimenter was directed to initiate the procedure by engaging the infant in a face-to-face interaction (see Figure 2). While she spoke in an animated way, she refrained from touching the baby throughout the interaction. After one minute, the experimenter assumed an expressionless face while continuing to look at the infant but without responding to any of the infant's behavior (see Figure 3). After two minutes, the experimenter resumed a playful interaction with the infant for one minute, as she had done in the first Play phase.

The entire still face session was videotaped with two cameras. One camera was focused on the experimenter to verify that she followed the directions for the procedure, while the other camera captured the infant's behavior across the three phases of the study. The recordings were

filmed and displayed together on a split screen and were later digitized onto a computer to allow for coding with "Event Coder" software (Goldstein & Brodsky, 2006).

Figure 2. Experimenter interacts with infant during Play 1, the first interaction period.

Figure 3. Experimenter maintains a still face while infant averts her gaze during the 2-minute still face period.

Coding

Each phase of the interaction (i.e. Play 1, Still Face, and Play 2) was coded individually for the frequency of smiles and non-cry vocalizations. Fussing, crying, and vegetative sounds such as coughs were excluded from analysis. Smiles were coded frame-by-frame and were defined as occurring whenever an infant raised either one or both corners of the mouth by moving the zygomatic muscle (e.g. Jones, Collins, & Hong, 1991).

The 10-minute caregiver-infant play sessions were coded for infant behaviors and their corresponding caregiver responses. Caregiver responsiveness was coded using a system based on Gros-Louis et al. (2006) and Bornstein et al. (1992). Caregiver and infant behaviors were classified into the following mutually-exclusive categories:

1) object-related non-vocal: non-verbal behaviors that involve an object
   (e.g. manipulating, showing, pointing at, looking at, or getting a toy)
2) object-related vocal: any category #1 behavior (see above) paired with a vocalization that refers to the object
   (e.g. infant makes an object-directed vocalization while looking at ball; mom says, “Look at the ball!” while pointing at it)
3) dyadic non-vocal: face-to-face interaction with the baby that involves eye contact and/or physical contact (e.g., smiling at, touching, picking up)
4) dyadic vocal: any category #3 behavior (see above) paired with a non-cry vocalization (babbling, cooing, talking)
5) distress vocalization: crying or extreme fussing
6) other verbal/vocal: any vocalization that does not fit within the above categories #2, #4, or #5 (e.g. laughing; mom narrating aloud while she gets items out of

diaper bag, etc.)

In rare instances in which more than one of the above behaviors occurred at the same time, certain behaviors took precedence over the others to ensure that all categories were mutually exclusive. Specifically, distress vocalizations overpowered all other categories. In addition, in situations in which infants were manipulating a toy, yet engaged with their caregivers at the same time, their behavior was coded based on whichever activity captured their most immediate attention, as coded by the direction of infant eye gaze. Caregiver responses were only credited as being responsive if they occurred within 5 seconds of the infant "trigger" behavior, and represented a change in the caregiver's ongoing behavior (Bornstein et al., 1992).

Results

Vocalizations during the Still Face Interaction

The first analysis explored whether infant non-cry vocalizations differed significantly across the three periods of the still face interaction and across age. A 2 (Age) x 3 (Period) mixed ANOVA did not show a significant main effect of period, $F(2, 50) = 1.61$, *ns*, or age $F(1, 25) = .551$, *ns*. However, a significant interaction between period and age was found, $F(2, 50) = 4.17$, $p < .05$.

The interaction was followed up with tests of simple main effects. No main effect of period was found for 2-month-olds, $F(2, 28) = .388$, *ns* (Figure 4A). However, a significant main effect of period was found for 5-month-olds, $F(2, 22) = 4.61$, $p < .05$. Post-hoc tests revealed that 5 month olds significantly increased the number of vocalizations from the first interaction period to the still face period, Tukey's HSD $p < .05$, (Figure 4B). There was no significant change in vocalizing from the still face to the second interaction period, or from the first interaction period to the second interaction period.

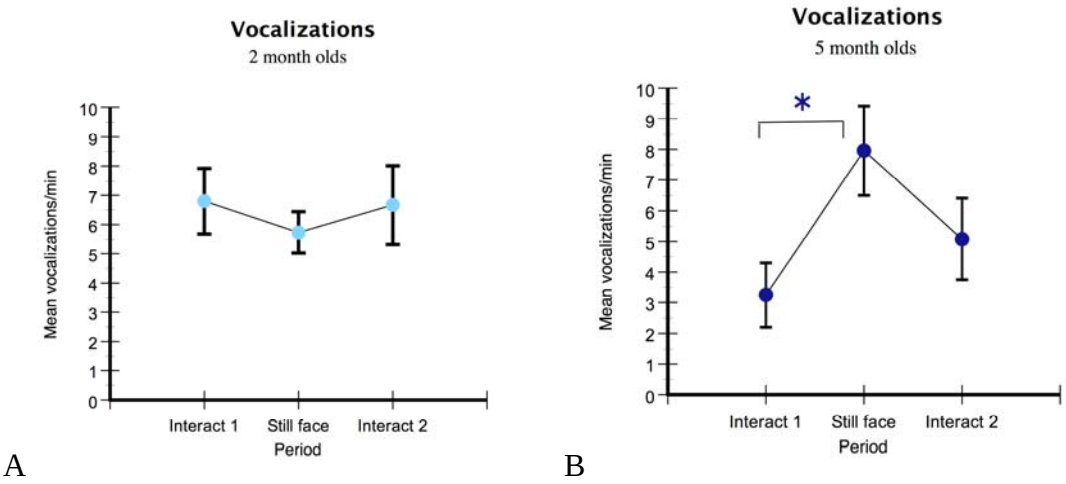

Figure 4.. (A) 2-month-olds' mean number of non-cry vocalizations per minute during the 4 minutes of the still face interaction. (B) 5-month-olds' mean number of non-cry vocalizations per minute during the 4 minutes of the still face interaction.

Smiles during the Still Face Interaction

A 2 (Age) x 3 (Period) ANOVA was conducted to evaluate the effects of age and period of the still face interaction on the frequency of infants' smiles. There was a significant main effect of period, $F(2, 50) = 5.45$, $p < .01$, but not of age, $F(1, 25) = .469$, *ns*. A marginally significant interaction between period and age was found, $F(2, 50) = 4.17$, $p = .07$.

Tests of simple main effects were conducted to follow up the marginally-significant interaction. A significant main effect of period was found for 2-month-olds, $F(2, 28) = 7.68$, $p < .01$. No main effect of period was found for 5-month-olds, $F(2, 22) = 2.04$, *ns* (Figure 5B).

Post-hoc tests showed that 2-month-olds decrease the number of smiles from the first interaction period to the still face period, and from the first interaction period to the second interaction period, $p < .05$ (Figure 5A). There was no significant change in smiling from the still face to the second interaction period.

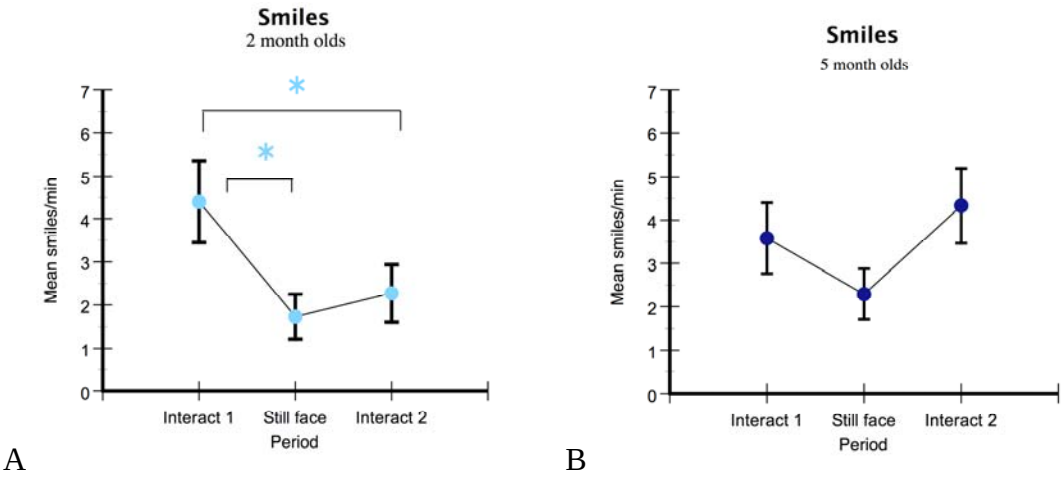

Figure 5. (A) 2-month-olds' mean number of smiles per minute during the 4 minutes of the still face interaction. (B) 5-month-olds' mean number of smiles per minute during the 4 minutes of the still face interaction.

Changes in vocalizing during the still face period

During the 2 minute still face, 2-month-olds exhibited a general decrease in vocalizations from the beginning of the period through the end of the period (Figure 6). The distribution of their vocalizations during the still face was best fit by an exponential function [$f(x)= -.12x^2 + 33.24$], $R^2 = .68$, $p < .05$.

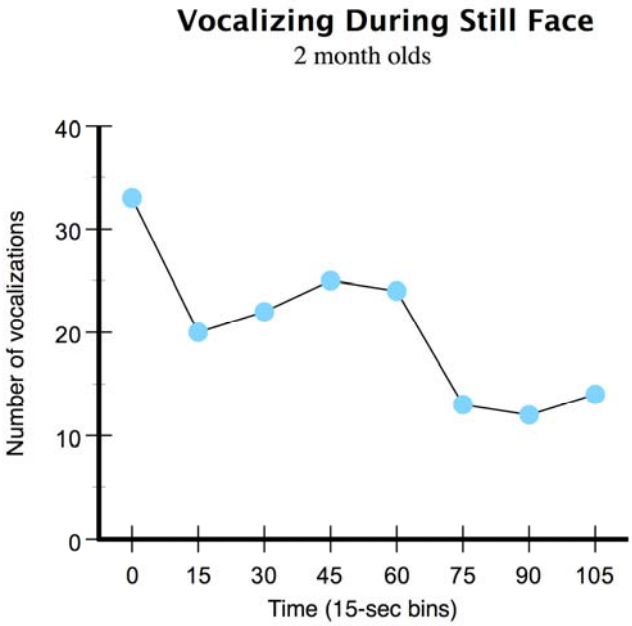

Figure 6. Distribution of 2-month-olds' vocalizations during the 2 minute still face period. Data are summed across infants for each 15-second bin.

During the 2 minute still face period, 5-month-olds exhibited an increase in vocalizations, which peaked at 60 seconds, followed by a decrease in vocalizations (Figure 7). The distribution of 5-month-olds' vocalizations during the still face was best fit by a quadratic function [$f(x)= -.86x^2 + 9.42x + 3.48$], $R^2 = .84$, $p = .01$.

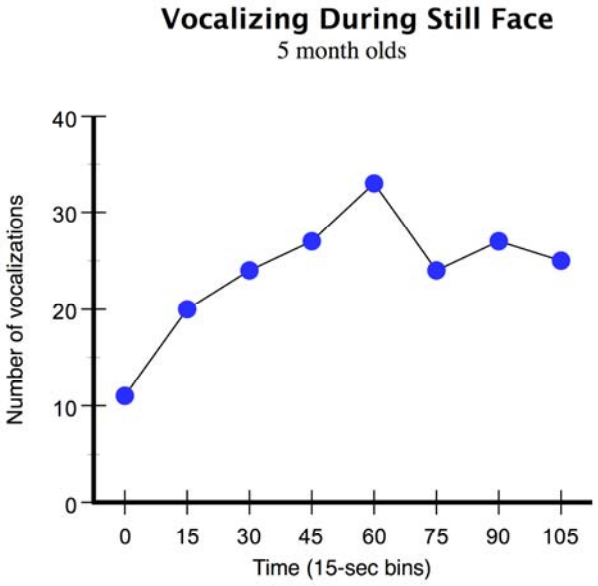

Figure 7. Distribution of 5-month-olds' vocalizations during the 2 minute still face period. Data are summed across infants for each 15-second bin.

Changes in smiling during the still face period

Two-month-olds did not show a consistent pattern in smiling behavior during the 2 minute still face (Figure 8). The distribution of their smiling during the still face was best fit by an inverse function [$f(x)= 6.74x^2 + 5.83$], $R^2 = .20$, $p = .27$.

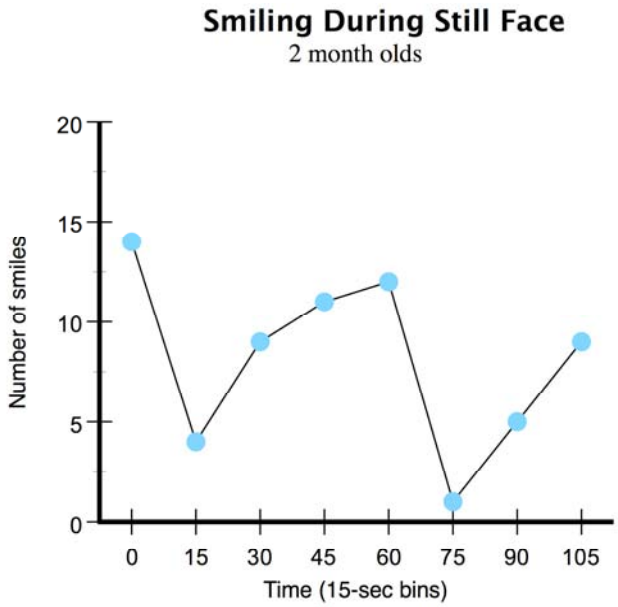

Figure 8. Distribution of 2-month-olds' smiles during the 2 minute still face period. Data are summed across infants for each 15-second bin.

Five-month-olds exhibited a general decrease in smiling during the 2 minute still face period (Figure 9). The distribution of their smiling was best fit by a logarithmic function [$f(x)= -3.89x^2 + 11.53$], $R^2 = .58$, $p < .05$.

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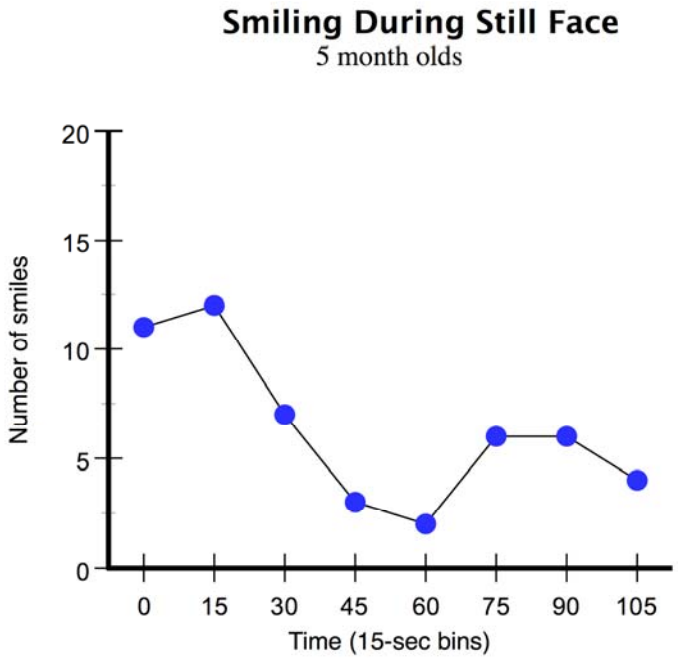


Figure 9. Distribution of 5-month-olds' smiles during the 2 minute still face period. Data are summed across infants for each 15-second bin.

Relations between vocalizing and smiling

Correlations between vocalizations and smiles during the three periods of the still face were computed to evaluate whether vocalizing and smiling were related to one another. Table 1 shows the correlations for 2-month-olds. How much 2-month-olds vocalized during Interact 1 was related to how much they vocalized during the still face. Amount of smiling during Interact 1 was related to amount of smiling during both the still face and Interact 2. Vocalizing and smiling were found to be independent.

Table 1: Relations Between Vocalizing and Smiling for 2-month-olds

	Vocs: Interact 1	Vocs: Still face	Vocs: Interact 2	Smiles: Interact 1	Smiles: Still face	Smiles: Interact 2
Vocs: Interact 1	--	.65**	.27	.26	.36	-.14
Vocs: Still face		--	.28	.11	.49	-.05
Vocs: Interact 2			--	.33	0	.20
Smiles: Interact 1				--	.63*	.69**
Smiles: Still face					--	.5
Smiles: Interact 2						--

Cell contents: Pearson correlation, *$p < .05$, **$p < .01$

Table 2 shows the correlations for 5-month-olds. How much they vocalized during Interact 1 was related to how much they vocalized during Interact 2. No relations were found between smiling during the three different periods. Amount of smiling during the still face was, however, related to amount of vocalizing during the still face. During the interaction periods, vocalizing and smiling were independent behaviors for 5-month-olds.

Table 2: Relations Between Vocalizing and Smiling for 5-month-olds

	Vocs: Interact 1	Vocs: Still face	Vocs: Interact 2	Smiles: Interact 1	Smiles: Still face	Smiles: Interact 2
Vocs: Interact 1	--	-.01	.88**	.49	.16	.29
Vocs: Still face		--	.20	-.05	.72**	-.34
Vocs: Interact 2			--	.37	.12	.08
Smiles: Interact 1				--	.25	.39
Smiles: Still face					--	-.16
Smiles: Interact 2						--

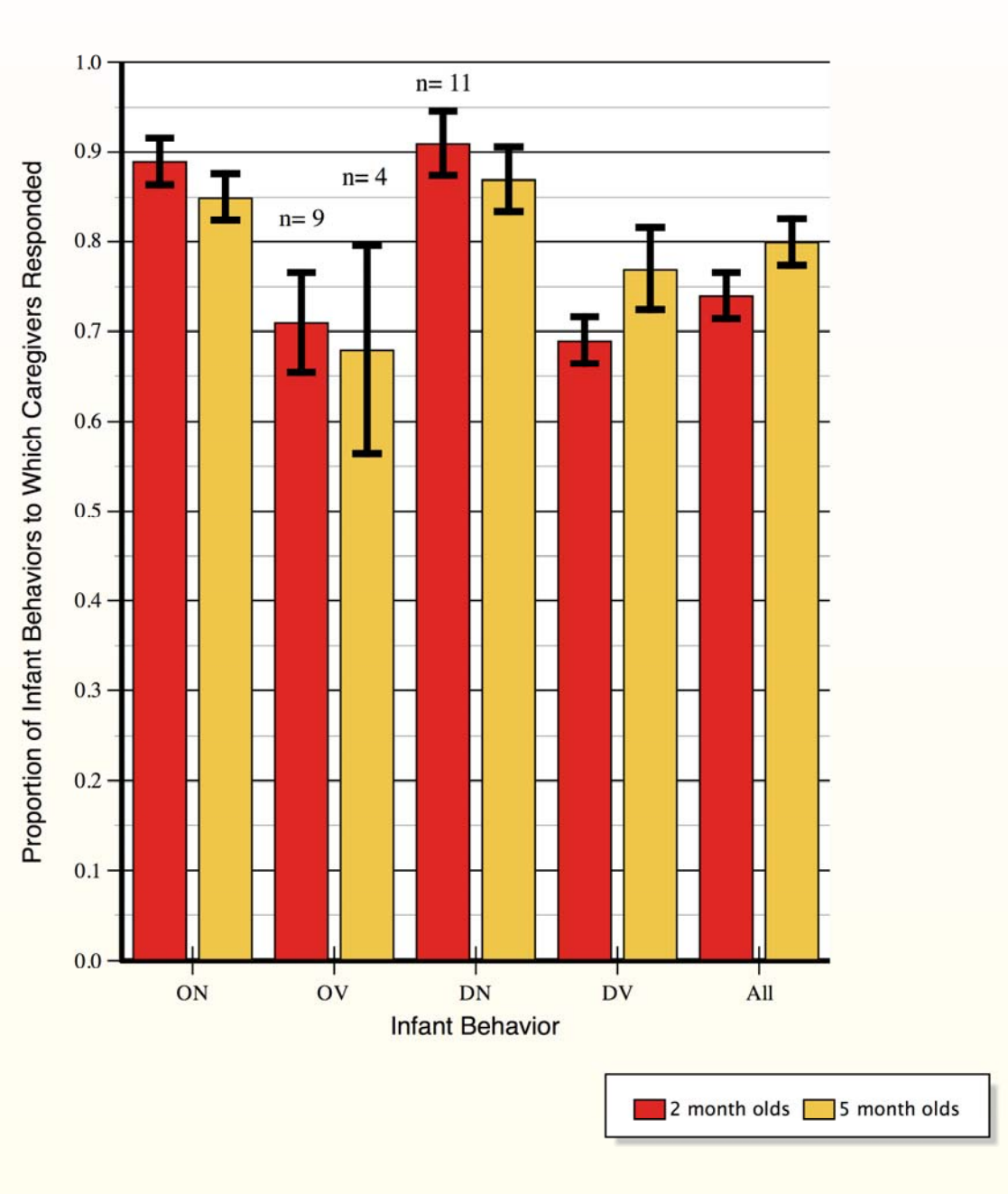
Cell contents: Pearson correlation, **$p < .01$

Measures of caregiver responsiveness

Five types of caregiver responsiveness measures were computed for each caregiver based on data collected from each caregiver-infant dyad's 10 minute, naturalistic play session. The five different measures of caregiver responsiveness were: 1) responses to infant object-related non vocal behaviors (e.g. looking at or manipulating a toy), 2) responses to infant object-related vocalizations (e.g. infant babbles while looking at a toy), 3) responses to infant dyadic non-vocal behaviors (e.g. infant looks or smiles at mom), 4) responses to infant dyadic vocalizations (e.g. infant vocalizes while engaged in a face-to-face interaction with mom), and 5) overall caregiver responses (a combination of all caregiver responses described in the prior 4 categories into a single proportion of the total number of infant behaviors to which caregivers responded).

Each measure of caregiver responsiveness was compared across infant age groups to evaluate whether caregivers of 2-month-olds respond differently than caregivers of 5-month-olds to specific infant behaviors. Figure 10 depicts proportions of caregivers' responses to the types of behavior categories as a function of infant age. Caregivers of infants who did not exhibit a particular behavior were excluded from the proportion calculation for that particular behavior. For this reason different measures have different sample sizes. No age-related differences in caregivers' responses were found. Tables 3 and 4 depict the range of the proportion of infant behaviors to which caregivers responded, by infant age.

Figure 10. Proportion of Caregiver Responses to Categories of Infant Behavior, By Infant Age



Notes: Infant Behaviors:
- ON= object-related non-vocals
- OV= object-related vocals
- DN= dyadic non-vocals
- DV= dyadic vocals
-All= all infant behaviors

Unless otherwise noted: n= 13 for 2-month-olds and n= 9 for 5-month-olds (caregivers of infants who did not exhibit a particular behavior during the play session were excluded from the proportion calculation for that particular behavior)

Table 3. Range of Proportion of Infant Behaviors to Which Caregivers Responded, 2-month-old infants

Infant Behavior	Range of Proportion of Infant Behaviors to Which Caregivers Responded
Object-related non-vocals	.64 - 1
Object-related vocals	.50 - .83
Dyadic non-vocals	.58 - 1
Dyadic vocals	.42 - .82
All infant behaviors	.49 - .88

Table 4. Range of Proportion of Infant Behaviors to Which Caregivers Responded, 5-month-old infants

Infant Behavior	Range of Proportion of Infant Behaviors to Which Caregivers Responded
Object-related non-vocals	.72 - .98
Object-related vocals	.25 - 1
Dyadic non-vocals	.67 - 1
Dyadic vocals	.53 - 1
All infant behaviors	.62 - .90

Relations between infant behaviors during the still face and measures of caregiver responsiveness, by age of infant

Correlations were computed to evaluate whether changes in infants' vocalizations and smiles from Interact 1 to Still Face were related to measures of caregiver responsiveness. To do so, difference scores were computed for vocalizations and smiles across the two periods, for each age. Table 5 shows the correlations for 2-month-olds. Table 6 shows the correlations for 5-month-olds. No significant correlations were found.

Table 5. Correlations between caregiver responses to infant behaviors and changes in vocalizing and smiling from Interact 1 to Still Face for 2-month-olds

	Proportion of infant object-related non-vocals to which caregiver responded	Proportion of infant object-related vocals to which caregiver responded	Proportion of infant dyadic non-vocals to which caregiver responded	Proportion of infant dyadic vocals to which caregiver responded	Proportion of all infant behaviors to which caregiver responded
Change in mean amount of vocalizations from Interact 1 to Still face	-.09	-.02	.01	-.45	-.30
Change in mean amount of smiles from Interact 1 to Still face	-.16	.37	-.28	-.29	-.22

Table 6. Correlations between caregiver responses to infant behaviors and changes in vocalizing and smiling from Interact 1 to Still Face for 5-month-olds

	Proportion of infant object-related non-vocals to which caregiver responded	Proportion of infant object-related vocals to which caregiver responded	Proportion of infant dyadic non-vocals to which caregiver responded	Proportion of infant dyadic vocals to which caregiver responded	Proportion of all infant behaviors to which caregiver responded
Change in mean amount of vocalizations from Interact 1 to Still face	-.33	.37	-.17	.35	.12
Change in mean amount of smiles from Interact 1 to Still face	-.45	.15	-.45	.54	.06

Consistency of caregiver responsiveness across infant behaviors

Correlations were computed to evaluate whether caregiver responsiveness to a particular type of infant behavior was predictive of caregiver responsiveness to other types of infant behaviors. Correlations were computed separately for each infant age group. Table 7 shows the correlations for caregivers of 2-month-olds. The proportion of infants' object-related non-vocals (e.g. looks at an object) to which caregivers responded was positively related to the proportion of infant dyadic vocalizations to which the caregiver responded, as well as the caregiver's overall level of responsiveness. Additionally, there was a positive relationship between the proportion of infant dyadic vocalizations to which the caregiver responded and the caregiver's overall level of responsiveness.

Table 7. Correlations between caregivers' responses to different types of infant behaviors, for caregivers of 2-month-olds

	Proportion of infant object-related non-vocals to which caregiver responded	Proportion of infant object-related vocals to which caregiver responded	Proportion of infant dyadic non-vocals to which caregiver responded	Proportion of infant dyadic vocals to which caregiver responded	Proportion of all infant behaviors to which caregiver responded
Proportion of infant object-related non-vocals to which caregiver responded	--	-.48	.22	.56*	.67*
Proportion of infant object-related vocals to which caregiver responded		--	-.06	-.08	-.03
Proportion of infant dyadic non-vocals to which caregiver responded			--	.30	.41
Proportion of infant dyadic vocals to which caregiver responded				--	.93**
Proportion of all infant behaviors to which caregiver responded					--

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

Table 8 shows the correlations for caregivers of 5-month-olds. The only significant relationship that was found between different types of caregiver responsiveness was a positive relationship between the proportion of infant dyadic vocalizations to which the caregiver responded, and the caregiver's overall level of responsiveness.

Table 8. Correlations between caregivers' responses to different types of infant behaviors, for caregivers of 5-month-olds

	Proportion of infant object-related non-vocals to which caregiver responded	Proportion of infant object-related vocals to which caregiver responded	Proportion of infant dyadic non-vocals to which caregiver responded	Proportion of infant dyadic vocals to which caregiver responded	Proportion of all infant behaviors to which caregiver responded
Proportion of infant object-related non-vocals to which caregiver responded	--	.06	.49	-.26	.56
Proportion of infant object-related vocals to which caregiver responded		--	.41	.06	.18
Proportion of infant dyadic non-vocals to which caregiver responded			--	.03	.67*
Proportion of infant dyadic vocals to which caregiver responded				--	.45
Proportion of all infant behaviors to which caregiver responded					--

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

Discussion

The results from the present study support the idea that 5-month-olds have learned that their non-cry vocalizations have an effect on others, whereas two-month-olds have not. Five-month-olds demonstrated their knowledge of this concept by significantly increasing their babbling from the first interaction period to the still face period. Two-month-olds, on the other hand, did not show a difference in the amount of vocalizations across the two periods. During the still face period, 5-month-olds showed an initial increase in babbling, followed by a decrease in babbling as the period went on. Two-month-olds simply showed a general decrease in vocalizations throughout the still face period.

Additionally, two-month-olds exhibited a significant decrease in smiling from Play 1 to the still face, and from Play 1 to Play 2. While 5-month-olds did not show any significant difference in smiling across the three interaction periods, the general trend was a decrease in smiling from Play 1 to Still Face, followed by an increase in smiling from Still Face to Play 2. This trend is consistent with the significant decrease and then increase in smiling reported by Goldstein et al. (submitted). In terms of smiling during the still face period, 5-month-olds showed a logarithmic decrease, whereas 2-month-olds did not exhibit any consistent pattern.

In some cases, smiling or vocalizing was consistent across different periods of the still face interaction. In particular, for 2-month-olds, the amount of vocalizations during Play 1 was related to the amount of vocalizations during the still face. Also, the amount that 2-month-olds smiled during Play 1 was related to how much they smiled during both the still face and Play 2. No relationships were found between vocalizing and smiling for any of the three periods, thus providing evidence that the behaviors are independent for 2-month-olds.

For 5-month-olds, the amount of vocalizing during Play 1 was related to the amount of vocalizing during Play 2. No relationship was found based on the amount that infants smiled during the three different periods. In general, vocalizing and smiling were found to be independent behaviors in 5-month-olds, with the one exception that the amount that infants vocalized during the still face was related to the amount that they smiled during the still-face.

In terms of caregiver responsiveness, no relationship was found between caregivers' overall levels of responsiveness and the change in vocalizing or smiling that their infants exhibited from Play 1 to the still face. Moreover, no relationship was found between any specific *type* of caregiver responsiveness (e.g. responses to infants' dyadic vocalizations) and whether infants showed a change in vocalizing or smiling from Play 1 to the still face. Also, caregivers of 2-month-olds were not found to respond any differently than caregivers of 5-month-olds to any of the different types of infant behaviors.

Data was also examined to investigate whether caregivers were consistent in their levels of responsiveness to the different types of behaviors exhibited by their infants. Overall, caregivers' levels of responsiveness were not found to be very consistent across infant behaviors. The only exceptions were as follows: for 2-month-olds, the proportion of the infant's object-related non-vocals (e.g. looks at an object) to which the caregiver responded was positively related to the proportion of infant dyadic vocalizations to which the caregiver responded, as well as the caregiver's overall level of responsiveness. Additionally, there was a positive relationship between the proportion of infant dyadic vocalizations to which the caregiver responded and the caregiver's overall level of responsiveness. For caregivers of 5-month-olds, the only relationship that was found between different types of caregiver responsiveness was a positive relationship

between the proportion of infant dyadic vocalizations to which the caregiver responded, and the caregiver's overall level of responsiveness.

All in all, findings from the present study regarding 5-month-olds' vocalizations throughout the still face interaction are generally consistent with those reported by Goldstein et al. (2007). The present study replicated Goldstein's finding that 5-month-olds exhibit a vocal extinction effect (i.e. a transient increase in vocalizations, followed by a decrease in vocalizations) when the social partner with whom they are interacting becomes unresponsive. In both studies, 5-month-olds showed a significant increase in babbling from Play 1 to Still Face. Whereas in Goldstein's study the infants subsequently showed a significant decrease in the amount of vocalizations from Still Face to Play 2, this was not the case for infants in the current study. This discrepancy may be a reflection of the fact that the current study was based on a sample size of only twelve 5-month-old infants, whereas Goldstein's study included data from thirty-eight infants. The distribution of 5-month-olds' vocalizations throughout the still face period, did, however mirror the distribution found by Goldstein, which was fit by a quadratic function.

In terms of smiling during the still face interaction, the present study did not find any significant difference in the amount exhibited by 5-month-olds across the three periods. Although smiling did not significantly differ as a function of period, the data replicate the general trend found by Goldstein whereby 5-month-olds exhibit a decrease in smiling from Play 1 to Still Face, followed by an increase in smiling from Still Face to Play 2. The fact that the pattern was not significant in the present study could simply be due to a lack of statistical power resulting from the small sample size. Data from the present study did, however, replicate

Goldstein's finding that 5-month-olds show a logarithmic decrease in smiling throughout the 2-minute still face period.

In Goldstein's study, it was also reported that vocalizing and smiling are independent of one another, with no relation between the two behaviors across the still face interaction for 5-month-old infants. While this finding was generally replicated by the current study, the only exception was that a relation was found between vocalizing and smiling of infants during the Still Face. This could be a spurious finding, again resulting from a small sample size, but more infants would have to be tested in order to confirm that this is the case.

In terms of the present study's data, perhaps it could be questioned whether 5-month-olds truly exhibited a vocal extinction effect. For instance, while the infants *did* show a significant increase in their amount of vocalizations from Play 1 to Still Face, they did *not* significantly decrease their vocalizations from Still Face to Play 2. Given this, is it possible that the increase in their vocalizations could have merely been due to a familiarization effect? Namely, is it possible that infants simply began to vocalize more as they "warmed up" to the experimenter, and became more comfortable with interacting with her? If this were true, than one would expect the amount that infants vocalized during the third period (Play 2) to differ significantly from the amount that infants vocalized during the first period (Play 1), and this was not found to be the case. Likewise, when the 5-month-olds' vocalizations throughout the still face were analyzed in 15-second bins, a clear quadratic pattern emerged in which vocalizations increased, peaking at 65 seconds, and then decreased. This pattern is indicative of an extinction effect.

While 5-month-olds exhibited a significant increase in vocalizations from Play 1 to Still Face, 2-month-olds did not. This supports the idea that 2-month-olds have not yet learned that their vocalizations may be used to elicit social responses from others. Is it possible, however, that

2-month-olds did not exhibit a vocal extinction effect because they were simply not as bothered by their social partner's unresponsiveness, and so were not as motivated to try to re-engage her? If this were the case, then it would follow that 2-month-olds would not exhibit much of a change in affective state when their social partner became unresponsive. The smile data suggest that this was not the case. Rather than being unaffected, 2-month-olds showed a significant decrease in smiling when the experimenter became unresponsive during the still face. Given that smiling has been found to be linked to affective state, the significant decrease in smiling exhibited by the infants may be interpreted as evidence that they were not unaffected by the still face (e.g. Messinger, 2005).

Alternatively, one could then argue that the decrease in 2-month-olds' smiling during the still face was not due to the fact that they were bothered by the experimenter's unresponsiveness, but rather due to the fact that having an unresponsive social partner meant that the infants had less opportunities to smile contingently upon social events initiated by the partner. Were this to be the case, then one would expect the infants' amount of smiling to increase once again during Play 2 when the experimenter resumed the face-to-face interaction. Data show that this was however not the case, as the infants did not display a significant increase in smiling from Still Face to Play 2.

Given that infants of both ages were affected by the still face, what, if any, types of behaviors did they use to try and re-engage their social partner? Smile data summed for infants of both ages during the 2 minute still face period shows that smiling peaked early at the beginning of the still face, and then tapered off through out the rest of the period. Infants of both ages thus appear to have used smiling as a technique to try and re-engage their social partner at the beginning of the still face. According to vocalization data, however, only 5-month-olds

vocalized significantly more when the experimenter became unresponsive. Had 2-month-olds been aware that their vocalizations could be used as a tool to try and elicit a response from another person, they probably would have attempted this technique as well.

Ultimately, the reason why 2-month-olds have not yet learned the relationship between their vocalizations and social responses from others may lie in the nature of the relationship itself. Previous studies have shown that 2-month-olds are capable of detecting contingencies based on their own behaviors, and that they exhibit extinction responses when the designated behaviors are no longer paired with their corresponding outcomes (Alessandri et. al, 1990; Lewis, Alessandri, & Sullivan, 1990). However, these studies were conducted in controlled, laboratory environments in which infants' behaviors were reinforced on a continuous schedule. The continual reinforcement allotted within a short period of time may have made the contingencies between the behaviors and their outcomes more salient for the infants to perceive and learn. On the contrary, in everyday life, mothers only respond to their infants' non-cry vocalizations about 50% of the time (Bornstein & Tamis-LeMonda, 1989; Green & Gustafson, 1997; Gros-Louis et al, 2006). Partial reinforcement schedules such as this are generally associated with more gradual learning curves (e.g. Millar, 1972).

In addition, another reason why 2-month-olds have not yet learned that their babbling has social consequences may be due to the nature of caregivers' responses to young infants' prelinguistic vocalizations. When infants' vocal repertoires are medium-to-large in size (and thus include fully-resonant sounds), mothers rely on infants' vocalizations to guide their responses to infant behaviors (Goldstein & West, 1999). When infants' vocal repertoires are small, however, such as those of 2-month-olds which consist only of "coos" and "goos," mothers rely more on visual cues rather than their infants' vocalizations to guide their responses. It may thus be the

case that 2-month-olds have not yet learned the association between their vocalizing and their caregiver's responses because their caregiver may be responding more to their actions or expressions, rather than their vocalizations.

Given the important role that social responses serve in shaping infant behaviors, one surprising finding from the present study was that there was no relationship between level of caregiver responsiveness and the change in infants' frequency of vocalizing and smiling from Play 1 to Still Face. Particularly surprising was the lack of relationship between caregiver level of responsiveness to infant vocalizations and the change in the amount of infants' vocalizations from Play 1 to Still Face. Thus, no support was found for the hypothesis that infants of highly-responsive caregivers would exhibit robust vocal extinction effects because they should have already learned the contingency between their vocalizations and their caregivers' responses.

Although the lack of a correlation between caregiver level of responsiveness and infant vocal behavior is surprising, there are a number of reasons why an existing relationship between the two variables may not have been detected by this study. First, it is possible that the brief caregiver-infant play session within the laboratory playroom did not provide an accurate measure of natural levels of caregiver responsiveness. It is possible, for instance, that caregivers were exceptionally responsive during the session as compared to how they naturally act at home because they felt as though they were being evaluated. This idea is supported by research that found that mothers are more responsive and active with their children in laboratory settings than they are at home (Belsky, 1980). In the current study caregivers of 2-month-old infants responded to their infants' dyadic vocalizations approximately 69% of the time, whereas caregivers of 5-month-old infants responded to their infants' dyadic vocalizations approximately 77% of the time. Both of these observed levels of responsiveness are quite high compared to the

50% rate at which mothers have been found to respond to their infants' non-cry vocalizations in everyday life (Bornstein & Tamis-LeMonda, 1989; Green & Gustafson, 1997). Given that nearly all of the caregivers in the present study responded to their infants' dyadic vocalizations above 50% of the time, it may be that a ceiling effect prevented true individual differences in caregiver responsiveness from being observed.

Additionally, the brief length of the 10-minute play session may have also contributed to the observed lack of individual differences in caregivers' levels of responsiveness. In some cases caregivers had to be excluded from analyses of responsiveness because their infants did not exhibit a particular type of behavior during the brief play session. Perhaps a longer session is needed to provide for more infant behaviors, and thus more opportunities for caregivers to respond to their infants. Also, the caregivers that participated in this study were primarily of European American descent and from middle-to upper-middle-class, intact households. In this sense, the sample is biased because it only represents a select group of all caregivers. It is quite possible that had the sample included caregivers from a variety of different backgrounds with more diverse personal characteristics (e.g. level of education, SES, ethnicity, family structure), that a relationship between caregiver level of responsiveness and infant vocal behavior may have been found.

Additionally, it could also be the case that the operational definition that credited a caregiver behavior as "responsive" may not have been stringent enough to distinguish between very responsive caregivers and their less-responsive counterparts. As was done in a previous study by Tamis-LeMonda, Bornstein, & Baumwell (2001), the current study defined a contingent response as one that occurred within 5 seconds of an infant non-vocal behavior, or 5 seconds after the offset of an infant vocalization. Other previous studies concerned with maternal

responsiveness, however, have used much smaller time windows. Both Hsu & Fogel (2003) and Gros-Louis et. al (2006), for example, only credited maternal responses as contingent if they occurred within 1 second of the offset of an infant vocalization. Perhaps a stricter operational definition may have detected the expected relationship between caregiver responsiveness and infant vocal behavior.

Given the acknowledged limitations of the present study, it is proposed that a future study based on the same procedure continue to test 2-month-old infants so as to obtain a larger, more representative sample. The 10 minute caregiver-infant play session should be extended to a length of 20-30 minutes to provide for more opportunities to assess caregiver responsiveness. If a ceiling effect is still observed in caregivers' levels of responsiveness, then the play session should take place outside of the laboratory to provide for a more ecologically-valid representation of caregivers' levels of responsiveness to their infants' behaviors. An effort should be made to recruit dyads of more diverse demographic backgrounds so that differences in caregiver responsiveness that may exist amongst various social and cultural groups are represented. Also, the window of time that a caregiver may respond to an infant behavior and still be credited as responsive should be decreased from 5 seconds to 1 second for vocalizations, and perhaps 2-3 seconds for other, non-verbal responses. Finally, data concerning infant temperament that was collected via the Infant Behavior Questionnaire (but was not analyzed for the present study) should be examined to see if it is in any way related to the relationship between caregiver responsiveness and infant vocal behavior across the still face (Gartstein & Rothbart, 2003). It may be the case that infant temperament moderates the described relationship because infants with difficult temperaments may have less opportunities to learn the contingency

between their vocalizations and their caregivers' responses due to their frequent states of agitation.

Moreover, to assure that 2-month-old infants have not learned that their vocalizations may be used to elicit responses from a social partner, the present procedure could be slightly modified so that mothers are the participants in the still face interaction, rather than an experimenter. Research has shown that 2-month-old infants are sensitive to social contingencies in face-to-face interactions with their mother and a stranger (Bigelow & Rochat, 2006). Of the two contingency levels, 2-month-olds prefer that of their mothers (presumably due to familiarity), and are thus less responsive to strangers whose contingency levels differ from their mothers'. Conducting the study with mothers could help to shed light on whether or not 2-month-olds are aware that their vocalizations can cause a change in *any*one's behavior.

Given that the results of the present study show that 5-month-olds, but not 2-montholds have learned that their babbling has instrumental value, future studies incorporating the same procedure should be conducted with infants of three and four months of age to find out when the onset of the vocal extinction effect occurs. It may also be the case that caregiver responsiveness towards infants at 3 and 4 months of age may be more predictive of whether or not infants exhibit a vocal extinction effect because these ages are representative of the time when the onset of the vocal extinction effect occurs. Furthermore, a study based on the same premise could adopt a longitudinal design rather than the current cross-sectional design, so that the same population of infants may be tested at multiple ages. Such a longitudinal design would allow the benefit of being able to examine individual differences amongst infants and would also permit an analysis of developmental changes in vocal behavior.

Furthermore, a study incorporating the SFP should be designed to ensure that when infants exhibit a vocal extinction effect, they are doing so because their *long*-term, rather than *short*-term, social expectancies have been violated. Namely, it should be verified that infants are vocalizing significantly more during the still face because they have learned the contingency between their own vocalizations and their caregivers' responses to these vocalizations over time. This could be established by proving that infants' increase in vocalizations is not alternatively due to a contingency that they have learned between their vocalizations and the experimenter's responses during the Play 1 period of the still face interaction. One way to control for this confound would be to have the experimenter respond to different infants at varying levels of contingency during Play 1 and to then see if these levels were predictive of whether or not infants exhibited a vocal extinction effect. Should whether or not infants exhibit a vocal extinction effect be based on their history of social interaction with their caregivers, then one would not expect to find any correlation between the rate with which the experimenter responds to the infants' vocalizations and whether or not the infants exhibit a vocal extinction effect.

All in all, although the current study is not without limitations, it presents a preliminary look at the development of young infants' understanding that their babbling has an effect on others. In the development of communication, infants must learn that their vocalizations have instrumental value. After they recognize that their vocalizations can be used to elicit social responses from others, they have more opportunities to interact with and learn from their parents. The findings from the present study suggest that infants learn that they can use their vocalizations as a tool to engage others sometime between the ages of 2 and 5 months. With further research, a more exact age for the emergence of this understanding may be determined. Establishing such an age could one day prove to be helpful as scholars seek to develop

innovative methods for predicting communicative delays in the earliest months of life. This study represents a valuable first step in the right direction.

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Appendix

Infant Behavior Questionnaire - Revised

Subject No. _____

Today's Date _____

Sex of Child _____

Date of Baby's Birth _____ ____ _____
month. day year

Age of Child _____ _____
mos. weeks

INSTRUCTIONS:
Please read carefully before starting:

As you read each description of the baby's behavior below, please indicate how often the baby did this during the LAST WEEK (the past seven days) by circling one of the numbers in the left column. These numbers indicate how often you observed the behavior described during the last week.

(1) Never	(2) Very Rarely	(3) Less Than Half the Time	(4) About Half the Time	(5) More Than Half the Time	(6) Almost Always	(7) Always	(X) Does Not Apply

The "Does Not Apply" (X) column is used when you did not see the baby in the situation described during the last week. For example, if the situation mentions the baby having to wait for food or liquids and there was no time during the last week when the baby had to wait, circle the (X) column. "Does Not Apply" is different from "Never" (1). "Never" is used when you saw the baby in the situation but the baby never engaged in the behavior listed during the last week. For example, if the baby did have to wait for food or liquids at least once but never cried loudly while waiting, circle the (1) column.

Please be sure to circle a number for <u>every</u> item.

Feeding

During feeding, how often did the baby:
1 2 3 4 5 6 7 X . . . . (1) lie or sit quietly?
1 2 3 4 5 6 7 X . . . . (2) squirm or kick?
1 2 3 4 5 6 7 X . . . . (3) wave arms?
1 2 3 4 5 6 7 X . . . . (4) notice lumpy texture in food (e.g., oatmeal)?

In the last week, while being fed in your lap, how often did the baby:
1 2 3 4 5 6 7 X . . . . (5) seem to enjoy the closeness?
1 2 3 4 5 6 7 X . . . . (6) snuggle even after she was done?
1 2 3 4 5 6 7 X . . . . (7) seem eager to get away as soon as the feeding was over?

How often did your baby make talking sounds:
1 2 3 4 5 6 7 X . . . . (8) while waiting in a high chair for food?
1 2 3 4 5 6 7 X . . . . (9) when s/he was ready for more food?
1 2 3 4 5 6 7 X . . . . (10) when s/he has had enough to eat?

Sleeping

Before falling asleep at night during the last week, how often did the baby:
1 2 3 4 5 6 7 X . . . . (11) show no fussing or crying?

During sleep, how often did the baby:
1 2 3 4 5 6 7 X . . . . (12) toss about in the crib?
1 2 3 4 5 6 7 X . . . . (13) move from the middle to the end of the crib?
1 2 3 4 5 6 7 X . . . . (14) sleep in one position only?

After sleeping, how often did the baby:
1 2 3 4 5 6 7 X . . . . (15) fuss or cry immediately?
1 2 3 4 5 6 7 X . . . . (16) play quietly in the crib?
1 2 3 4 5 6 7 X . . . . (17) cry if someone doesn't come within a few minutes?

How often did the baby:
1 2 3 4 5 6 7 X . . . . (18) seem angry (crying and fussing) when you left her/him in the crib?
1 2 3 4 5 6 7 X . . . . (19) seem contented when left in the crib?
1 2 3 4 5 6 7 X . . . . (20) cry or fuss before going to sleep for naps?

When going to sleep at night, how often did your baby:
1 2 3 4 5 6 7 X . . . . (21) fall asleep within 10 minutes?
1 2 3 4 5 6 7 X . . . . (22) have a hard time settling down to sleep?
1 2 3 4 5 6 7 X . . . . (23) settle down to sleep easily?

When your baby awoke at night, how often did s/he:
1 2 3 4 5 6 7 X . . . . (24) have a hard time going back to sleep?
1 2 3 4 5 6 7 X . . . . (25) go back to sleep immediately?

When put down for a nap, how often did your baby:
1 2 3 4 5 6 7 X . . . . (26) stay awake for a long time?
1 2 3 4 5 6 7 X . . . . (27) go to sleep immediately?
1 2 3 4 5 6 7 X . . . . (28) settle down quickly?

1 2 3 4 5 6 7 X . . . . (29) have a hard time settling down?

When it was time for bed or a nap and your baby did not want to go, how often did s/he:
1 2 3 4 5 6 7 X . . . . (30) whimper or sob?
1 2 3 4 5 6 7 X . . . . (31) become tearful?

Bathing and Dressing

When being dressed or undressed during the last week, how often did the baby:
1 2 3 4 5 6 7 X . . . . (32) wave her/his arms and kick?
1 2 3 4 5 6 7 X . . . . (33) squirm and/or try to roll away?
1 2 3 4 5 6 7 X . . . . (34) smile or laugh?
1 2 3 4 5 6 7 X . . . . (35) coo or vocalize?

When put into the bath water, how often did the baby:
1 2 3 4 5 6 7 X . . . . (36) smile?
1 2 3 4 5 6 7 X . . . . (37) laugh?
1 2 3 4 5 6 7 X . . . . (38) splash or kick?
1 2 3 4 5 6 7 X . . . . (39) turn body and/or squirm?

When face was washed, how often did the baby:
1 2 3 4 5 6 7 X . . . . (40) smile or laugh?
1 2 3 4 5 6 7 X . . . . (41) fuss or cry?
1 2 3 4 5 6 7 X . . . . (42) coo?

When hair was washed, how often did the baby:
1 2 3 4 5 6 7 X . . . . (43) smile?
1 2 3 4 5 6 7 X . . . . (44) fuss or cry?
1 2 3 4 5 6 7 X . . . . (45) vocalize?

Play

How often during the last week did the baby:
1 2 3 4 5 6 7 X . . . . (46) look at pictures in books and/or magazines for 2-5 minutes at a time?
1 2 3 4 5 6 7 X . . . . (47) look at pictures in books and/or magazines for 5 minutes or longer at a time?
1 2 3 4 5 6 7 X . . . . (48) stare at a mobile, crib bumper or picture for 5 minutes or longer?
1 2 3 4 5 6 7 X . . . . (49) play with one toy or object for 5-10 minutes?
1 2 3 4 5 6 7 X . . . . (50) play with one toy or object for 10 minutes or longer?
1 2 3 4 5 6 7 X . . . . (51) spend time just looking at playthings?
1 2 3 4 5 6 7 X . . . . (52) repeat the same sounds over and over again?
1 2 3 4 5 6 7 X . . . . (53) laugh aloud in play?
1 2 3 4 5 6 7 X . . . . (54) repeat the same movement with an object for 2 minutes or longer (e.g., putting a block in a cup, kicking or hitting a mobile)?
1 2 3 4 5 6 7 X . . . . (55) pay attention to your reading during most of the story when looking at picture books?
1 2 3 4 5 6 7 X . . . . (56) smile or laugh after accomplishing something (e.g., stacking blocks, etc.)?
1 2 3 4 5 6 7 X . . . . (57) smile or laugh when given a toy?
1 2 3 4 5 6 7 X . . . . (58) smile or laugh when tickled?

How often during the last week did the baby enjoy:
1 2 3 4 5 6 7 X . . . . (59) being sung to?
1 2 3 4 5 6 7 X . . . . (60) being read to?
1 2 3 4 5 6 7 X . . . . (61) hearing the sound of words, as in nursery rhymes?
1 2 3 4 5 6 7 X . . . . (62) looking at picture books?
1 2 3 4 5 6 7 X . . . . (63) gentle rhythmic activities, such as rocking or swaying?
1 2 3 4 5 6 7 X . . . . (64) lying quietly and examining his/her fingers or toes?
1 2 3 4 5 6 7 X . . . . (65) being tickled by you or someone else in your family?
1 2 3 4 5 6 7 X . . . . (66) being involved in rambunctious play?
1 2 3 4 5 6 7 X . . . . (67) watching while you, or another adult, playfully made faces?
1 2 3 4 5 6 7 X . . . . (68) touching or lying next to stuffed animals?
1 2 3 4 5 6 7 X . . . . (69) the feel of soft blankets ?
1 2 3 4 5 6 7 X . . . . (70) being rolled up in a warm blanket?
1 2 3 4 5 6 7 X . . . . (71) listening to a musical toy in a crib?

When playing quietly with one of her/his favorite toys, how often did your baby:
1 2 3 4 5 6 7 X . . . . (72) show pleasure?
1 2 3 4 5 6 7 X . . . . (73) enjoy lying in the crib for more than 5 minutes?
1 2 3 4 5 6 7 X . . . . (74) enjoy lying in the crib for more than 10 minutes?

When something the baby was playing with had to be removed, how often did s/he:
1 2 3 4 5 6 7 X . . . . (75) cry or show distress for a time?
1 2 3 4 5 6 7 X . . . . (76) seem not bothered?

When tossed around playfully how often did the baby:
1 2 3 4 5 6 7 X . . . . (77) smile?
1 2 3 4 5 6 7 X . . . . (78) laugh?

During a peekaboo game, how often did the baby:
1 2 3 4 5 6 7 X . . . . (79) smile?
1 2 3 4 5 6 7 X . . . . (80) laugh?

How often did your baby enjoy bouncing up and down:
1 2 3 4 5 6 7 X . . . . (81) while on your lap?
1 2 3 4 5 6 7 X . . . . (82) on an object, such as a bed, bouncer chair, or toy?

How often did the infant look up from playing:
1 2 3 4 5 6 7 X . . . . (83) when the telephone rang?
1 2 3 4 5 6 7 X . . . . (84) when s/he heard voices in the next room?

When your baby saw a toy s/he wanted, how often did s/he:
1 2 3 4 5 6 7 X . . . . (85) get very excited about getting it?
1 2 3 4 5 6 7 X . . . . (86) immediately go after it?

When given a new toy, how often did your baby:
1 2 3 4 5 6 7 X . . . . (87) get very excited about getting it?
1 2 3 4 5 6 7 X . . . . (88) immediately go after it?
1 2 3 4 5 6 7 X . . . . (89) seem not to get very excited about it?

Daily Activities

How often during the last week did the baby:

1 2 3 4 5 6 7 X . . . . (90) cry or show distress at a change in parents' appearance, (glasses off, shower cap on, etc.)?

1 2 3 4 5 6 7 X . . . . (91) when in a position to see the television set, look at it for 2 to 5 minutes at a time?

How often during the last week did the baby:

1 2 3 4 5 6 7 X . . . . (92) when in a position to see the television set, look at it for 5 minutes or longer?

1 2 3 4 5 6 7 X . . . . (93) protest being placed in a confining place (infant seat, play pen, car seat, etc)?

1 2 3 4 5 6 7 X . . . . (94) startle at a sudden change in body position (for example, when moved suddenly)?

1 2 3 4 5 6 7 X . . . . (95) appear to listen to even very quiet sounds?

1 2 3 4 5 6 7 X . . . . (96) attend to sights or sounds when outdoors (for example, wind chimes or water sprinklers)?

1 2 3 4 5 6 7 X . . . . (97) move quickly toward new objects?

1 2 3 4 5 6 7 X . . . . (98) show a strong desire for something s/he wanted?

1 2 3 4 5 6 7 X . . . . (99) startle to a loud or sudden noise?

1 2 3 4 5 6 7 X . . . . (100) look at children playing in the park or on the playground for 5 minutes or longer?

1 2 3 4 5 6 7 X . . . . (101) watch adults performing household activities (e.g., cooking, etc.) for more than 5 minutes?

1 2 3 4 5 6 7 X . . . . (102) squeal or shout when excited?

1 2 3 4 5 6 7 X . . . . (103) imitate the sounds you made?

1 2 3 4 5 6 7 X . . . . (104) seem excited when you or other adults acted in an excited manner around him/her?

When being held, how often did the baby:

1 2 3 4 5 6 7 X . . . . (105) pull away or kick?

1 2 3 4 5 6 7 X . . . . (106) seem to enjoy him/herself?

1 2 3 4 5 6 7 X . . . . (107) mold to your body?

1 2 3 4 5 6 7 X . . . . (108) squirm?

When placed on his/her back, how often did the baby:

1 2 3 4 5 6 7 X . . . . (109) fuss or protest?

1 2 3 4 5 6 7 X . . . . (110) smile or laugh?

1 2 3 4 5 6 7 X . . . . (111) wave arms and kick?

1 2 3 4 5 6 7 X . . . . (112) squirm and/or turn body?

When the baby wanted something, how often did s/he:

1 2 3 4 5 6 7 X . . . . (113) become upset when s/he could not get what s/he wanted?

1 2 3 4 5 6 7 X . . . . (114) have tantrums (crying, screaming, face red, etc.) when s/he did not get what s/he wanted?

When placed in an infant seat or car seat, how often did the baby:

1 2 3 4 5 6 7 X . . . . (115) wave arms and kick?

1 2 3 4 5 6 7 X . . . . (116) squirm and turn body?

1 2 3 4 5 6 7 X . . . . (117) lie or sit quietly?

1 2 3 4 5 6 7 X . . . . (118) show distress at first; then quiet down?

When frustrated with something, how often did your baby:
1 2 3 4 5 6 7 X . . . . (119) calm down within 5 minutes?

When your baby was upset about something, how often did s/he:
1 2 3 4 5 6 7 X . . . . (120) stay upset for up to 10 minutes or longer?
1 2 3 4 5 6 7 X . . . . (121) stay upset for up to 20 minutes or longer?
1 2 3 4 5 6 7 X . . . . (122) soothe her/himself with other things (such as a stuffed animal, or blanket)?

When rocked or hugged, in the last week, how often did your baby:
1 2 3 4 5 6 7 X . . . . (123) seem to enjoy her/himself?
1 2 3 4 5 6 7 X . . . . (124) seemed eager to get away?
1 2 3 4 5 6 7 X . . . . (125) make protesting noises?

When reuniting after having been away during the last week how often did the baby:
1 2 3 4 5 6 7 X . . . . (126) seem to enjoy being held?
1 2 3 4 5 6 7 X . . . . (127) show interest in being close, but resisted being held?
1 2 3 4 5 6 7 X . . . . (128) show distress at being held?

When being carried, in the last week, how often did your baby:
1 2 3 4 5 6 7 X . . . . (129) seem to enjoy him/herself?
1 2 3 4 5 6 7 X . . . . (130) push against you until put down?

While sitting in your lap:
1 2 3 4 5 6 7 X . . . . (131) how often did your baby seem to enjoy her/himself?
1 2 3 4 5 6 7 X . . . . (132) how often would the baby not be content without moving around?

How often did your baby notice:
1 2 3 4 5 6 7 X . . . . (133) low-pitched noises, air conditioner, heating system, or refrigerator running or starting up?
1 2 3 4 5 6 7 X . . . . (134) sirens from fire trucks or ambulances at a distance?
1 2 3 4 5 6 7 X . . . . (135) a change in room temperature?
1 2 3 4 5 6 7 X . . . . (136) a change in light when a cloud passed over the sun?
1 2 3 4 5 6 7 X . . . . (137) sound of an airplane passing overhead?
1 2 3 4 5 6 7 X . . . . (138) a bird or a squirrel up in a tree?
1 2 3 4 5 6 7 X . . . . (139) fabrics with scratchy texture (e.g., wool)?

When tired, how often was your baby:
1 2 3 4 5 6 7 X . . . . (140) likely to cry?
1 2 3 4 5 6 7 X . . . . (141) show distress?

At the end of an exciting day, how often did your baby:
1 2 3 4 5 6 7 X . . . . (142) become tearful?
1 2 3 4 5 6 7 X . . . . (143) show distress?

For no apparent reason, how often did your baby:
1 2 3 4 5 6 7 X . . . . (144) appear sad?
1 2 3 4 5 6 7 X . . . . (145) seem unresponsive?

How often did your baby make talking sounds when:
1 2 3 4 5 6 7 X . . . . (146) riding in a car?
1 2 3 4 5 6 7 X . . . . (147) riding in a shopping cart?
1 2 3 4 5 6 7 X . . . . (148) you talked to her/him?

Two Week Time Span

When you returned from having been away and the baby was awake, how often did s/he:
1 2 3 4 5 6 7 X . . . . (149) smile or laugh?

When introduced to an unfamiliar adult, how often did the baby:
1 2 3 4 5 6 7 X . . . . (150) cling to a parent?
1 2 3 4 5 6 7 X . . . . (151) refuse to go to the unfamiliar person?
1 2 3 4 5 6 7 X . . . . (152) hang back from the adult?
1 2 3 4 5 6 7 X . . . . (153) never "warm up" to the unfamiliar adult?

When in the presence of several unfamiliar adults, how often did the baby:
1 2 3 4 5 6 7 X . . . . (154) cling to a parent?
1 2 3 4 5 6 7 X . . . . (155) cry?
1 2 3 4 5 6 7 X . . . . (156) continue to be upset for 10 minutes or longer?

When visiting a new place, how often did the baby:
1 2 3 4 5 6 7 X . . . . (157) show distress for the first few minutes?
1 2 3 4 5 6 7 X . . . . (158) continue to be upset for 10 minutes or more?
1 2 3 4 5 6 7 X . . . . (159) get excited about exploring new surroundings?
1 2 3 4 5 6 7 X . . . . (160) move about actively when s/he is exploring new surroundings?

When your baby was approached by an unfamiliar person when you and s/he were out (for example, shopping), how often did the baby:
1 2 3 4 5 6 7 X . . . . (161) show distress?
1 2 3 4 5 6 7 X . . . . (162) cry?

When an unfamiliar adult came to your home or apartment, how often did your baby:
1 2 3 4 5 6 7 X . . . . (163) allow her/himself to be picked up without protest?
1 2 3 4 5 6 7 X . . . . (164) cry when the visitor attempted to pick her/him up?

When in a crowd of people, how often did the baby:
1 2 3 4 5 6 7 X . . . . (165) seem to enjoy him/herself?

Did the baby seem sad when:
1 2 3 4 5 6 7 X . . . . (166) caregiver is gone for an unusually long period of time?
1 2 3 4 5 6 7 X . . . . (167) left alone/unattended in a crib or a playpen for an extended period of time?

When you were busy with another activity, and your baby was not able to get your attention, how often did s/he:
1 2 3 4 5 6 7 X . . . . (168) become sad?
1 2 3 4 5 6 7 X . . . . (169) cry?

When your baby saw another baby crying, how often did s/he:
1 2 3 4 5 6 7 X . . . . (170) become tearful?
1 2 3 4 5 6 7 X . . . . (171) show distress?

When familiar relatives/friends came to visit, how often did your baby:
1 2 3 4 5 6 7 X . . . . (172) get excited?
1 2 3 4 5 6 7 X . . . . (173) seem indifferent?

Soothing Techniques

Have you tried any of the following soothing techniques in the last two weeks? If so, how quickly did your baby soothe using each of these techniques? Circle (X) if you did not try the technique during the LAST TWO WEEKS.

When rocking your baby, how often did s/he:
1 2 3 4 5 6 7 X . . . . (174) soothe immediately?
1 2 3 4 5 6 7 X . . . . (175) not soothe immediately, but in the first two minutes?
1 2 3 4 5 6 7 X . . . . (176) take more than 10 minutes to soothe?

When singing or talking to your baby, how often did s/he:
1 2 3 4 5 6 7 X . . . . (177) soothe immediately?
1 2 3 4 5 6 7 X . . . . (178) not soothe immediately, but in the first two minutes?
1 2 3 4 5 6 7 X . . . . (179) take more than 10 minutes to soothe?

When walking with the baby, how often did s/he:
1 2 3 4 5 6 7 X . . . . (180) soothe immediately?
1 2 3 4 5 6 7 X . . . . (181) not soothe immediately, but in the first two minutes?
1 2 3 4 5 6 7 X . . . . (182) take more than 10 minutes to soothe?

When giving him/her a toy, how often did the baby:
1 2 3 4 5 6 7 X . . . . (183) soothe immediately?
1 2 3 4 5 6 7 X . . . . (184) not soothe immediately, but in the first two minutes?
1 2 3 4 5 6 7 X . . . . (185) take more than 10 minutes to soothe?

When showing the baby something to look at, how often did s/he:
1 2 3 4 5 6 7 X . . . . (186) soothe immediately?
1 2 3 4 5 6 7 X . . . . (187) not soothe immediately, but in the first two minutes?
1 2 3 4 5 6 7 X . . . . (188) take more than 10 minutes to soothe?

When patting or gently rubbing some part of the baby's body, how often did s/he:
1 2 3 4 5 6 7 X . . . . (189) soothe immediately?
1 2 3 4 5 6 7 X . . . . (190) not soothe immediately, but in the first two minutes?
1 2 3 4 5 6 7 X . . . . (191) take more than 10 minutes to soothe?

Participant Questionnaire

About yourself:

1. What is your age? _____ Your spouse's age? _____

2. Is English the primary language spoken at home? _____
   List any other languages your infant hears regularly.

3. Circle the highest educational level you have attained:

   None (please go to 3a)
   High school diploma or equivalent
   Associate degree
   Vocational degree
   partial college
   Bachelor's degree
   Master's degree
   Ph.D, J.D., M.D., etc.

3a. If you answered "none" above, what is the highest grade in school that you completed? ____

4. What is your racial/ethnic identity?

   White (non-Hispanic)
   African American
   Puerto Rican
   Mexican
   Cuban
   Japanese
   Chinese
   Vietnamese
   Korean
   American Indian
   Pacific Islander
   Asian Indian
   Other (please specify) _____

5. Do you work outside the home? _____
   If so, what is your occupation?

6. What is your spouse's occupation? _____

About your baby:

1. How old is your infant?

2. If you have other children, what are their ages?

3. Was your infant premature? _____ If so, were there any complications?

4. What activities have you and your baby done this morning?

5. What sort of mood has he/she been in today?

6. Did he/she get a good night's sleep last night?

7. Has he/she been sick during the last week?

8. Is your voice different when you talk to your baby?_____ If so, how?

8a. How does your infant respond to your speech?

9. Do you think your baby responds more to your voice or to your facial expressions and gestures?_____ If so, how?

10. What sounds does your baby like to listen to?

11. What kinds of games do you like to play with your infant?

12. What kinds of activities encourage your infant to vocalize?

Author Note

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