

MATERNAL BEHAVIORS FOLLOWING

INFANT VOCALIZATION

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by

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INFANT VOCALIZATION

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ABSTRACT

Studies of maternal responsiveness suggest responsive maternal utterances may encourage infant behaviors important to mastering speech and language. However, little is known about instances in which mothers are non-responsive. This study examined maternal non-responsive utterances and nonverbal actions in 35 mother-infant dyads when infants were 4, 6, 8, 10, 12, or 14 months old, using a cross-sectional design. Maternal utterances deemed non-responsive to infant vocalizations in this study were divided into five mutually exclusive categories (activity comment, comment on new infant action, game/routine, redirect, and unchanged classification). Maternal nonverbal actions that occurred within 3 seconds of infant vocalizations were also investigated. Responsive nonverbal actions were defined as contingent upon and relevant to the preceding infant vocalization. Maternal actions included head nods, comfort behaviors, object-related behaviors, increased proximity, and repositioning. Maternal actions that occurred with maternal responsive utterances, non-responsive utterances, and silences were investigated. Results revealed mothers often produced activity comments rather than responding to infants' vocalizations directly. Mothers combined responsive actions with responsive or non-responsive utterances more often than with silences; however, object-related responsive but nonverbal actions were common across all categories studied. In conclusion, mothers frequently responded to infant vocalizations with appropriate verbal and nonverbal behaviors.

Chapter 1

INTRODUCTION

Infants learn language through social interactions with their caregivers. Positive social feedback from mothers provides infants with a sense of security giving them confidence to explore their environment and opportunities to learn how vocalizations can result in a change of maternal behavior (Bell & Ainsworth, 1972). The literature suggests mothers often respond to infant vocalizations with verbal utterances and these responses may encourage behaviors important to mastering speech and language (Gros-Louis, West, Goldstein, & King, 2006). For example, when mothers responded to (i.e., imitated) infants' consonant-vowel vocalizations significantly more often than infants' vowel only vocalizations, the more complex (i.e., consonant-vowel) speech forms increased (Gros-Louis et al., 2006).

Mothers' verbal input that is unrelated to infants' vocalizations may also serve a function in language development. While verbal feedback is essential to enhance infants' communication skills, mothers' nonverbal actions following infants' vocalizations may be equally important for infant language development. The present study examined the function of maternal non-responsive utterances and mothers' actions following infant vocalizations.

The literature on infants' vocal development and mothers' input within face-to-face interactions will be reviewed, followed by a review of maternal responsiveness and

the developmental benefits of maternal responsiveness. Finally, this study's research questions will be introduced.

Development of Infant Vocalizations

According to Oller and Griebel (2008), infant vocalizations develop in predictable stages. During the first stage and first few weeks of life, quasivowels (i.e., phonation in the absence of articulatory constriction) emerge in infants' vocal repertoire when alone and in the presence of others. At two to three months of age, infants shape these quasivowel vocalizations into early syllables, squeals, and vowels. Next, in the months following the appearance of early syllables, infants enter into the "expansion stage." In this period of vocal development, infants repeat sequences of vocalizations in an exploratory manner. Finally, infants babble canonical syllables by the 5th to 10th months of life. Canonical syllables consist of a vowel and a consonant-like articulatory movement, with a quick and smooth transition between the two sounds.

Across cultures, infants also demonstrate the ability to perceptually segment speech sounds and by 9 months they can detect patterns of phonemes that are possible in their native language (Kuhl, 2000). Infants as young as 7 months of age utilize statistical properties of verbal input in order to identify likely words. Exposure to the native language alters their perception, and influences the way infants organize, encode, and categorize words (Kuhl, 2000). Each of these infant abilities requires verbal input from the environment, and caregivers are the main source of input for infants. While infants can learn new words from overhearing conversations not directed toward them (Floor & Akhtar, 2006), infants' early lexical repertoires are positively influenced

by speech directed toward them (Carpenter, Nagell, & Tomasello, 1998). Input directed toward infants helps establish joint attention which aids in infants' ability to map words to their referents (Carpenter et al., 1998). Adults influence the context of language acquisition by strategically selecting the type of input directed towards infants (Nelson, 1973). In turn, the infants' processing strategies, such as those described above, may influence adults' selection strategies (Nelson, 1973). For example, infants easily learned names of salient objects they could act on, and mothers frequently labeled objects in the presence of infants (Nelson, 1973).

Infants depend on social interactions to successfully acquire their native language (Bateson, 1975). During normal routines, mothers and infants typically interact within three feet of one another, allowing opportunities for joint attention or eye contact. Bateson (1975) reported mothers often produced an utterance then paused and waited for an infant vocalization before speaking again. These proto-conversations were different from adult conversations in that they did not involve the exchanging of meaningful information, but instead focused on turn taking as well as maintaining attention and social contact. Bateson also found this process was enjoyable, pleasurable, and gratifying for both mothers and infants (1975). Therefore, language learning in the context of mother-infant interactions was potentially motivating for the infants.

Infants may also be motivated to vocalize because, in the social context of language learning, they discover their own vocal behavior can change adult behavior. For example, within the first 3 months of life, infants produced distress vocalizations

(i.e., crying) to signal their hunger, discomfort, or desire for closer proximity (Bell & Ainsworth, 1972). However, by 9-12 months infants cried more frequently when in close proximity to their mothers than when alone, suggesting these distress vocalizations were communicative and goal-directed (Bell & Ainsworth, 1972). Therefore, early infant vocalizations are cues that guide adult behavior. Not surprisingly, mothers of infants are excellent and consistent decoders of these communicative attempts, even when judging infants other than their own (Goldstein & West, 1999). For example, mothers consistently recognized and appropriately responded to infants' signals of distress or desire (Goldstein & West, 1999).

Maternal Input

Caregivers alter their input to infants by utilizing a speaking style known as infant-directed speech (i.e., motherese). Infant-directed speech (IDS) is different from adult-directed speech because it is higher in pitch and consists of exaggerated intonation (Fernald, 1985; Kuhl, 2000). Additionally, IDS is linguistically simpler (i.e., more redundant and repetitive, using new words in a variety of salient contexts) than adult-directed speech (Kuhl, 2000; Snow, 1972). Fernald (1985) found infants as young as 4 months of age preferred IDS over adult-directed speech using the head-turn paradigm. Moreover, IDS facilitated infants' ability to segment speech, map native-language input, and establish turn-taking abilities, all important prerequisites to speech (Kuhl 2000; Snow, 1972).

Within parent-infant interactions, parental "bids" (i.e., verbal and nonverbal signals toward the infant) changed with increased infant age. Research during

naturalistic play in home environments showed that the most frequent parental bids to 7-month-old infants were social interactive bids (i.e., attempts to engage the infant), followed by influence attempts (i.e., asking the infant to start or stop an activity), and then mood regulation (i.e., comforting, soothing, or distracting from distress; Kochanska & Aksan, 2004). However, at 15 months of age, influence attempts were most frequent, followed by social-interactive bids; mood regulation attempts remained the least frequent parental bid (Kochanska & Aksan, 2004). Therefore, infant age influenced the function of mothers' verbal and pragmatic behavior within interactions.

Maternal Responses

While all maternal input directed toward infants has the potential to facilitate language acquisition, input following infant vocalizations may be most beneficial, as it provides immediate feedback to shape the development of infant vocalizations. Cross-cultural research by Fogel, Toda, and Kawai (1988) compared maternal responsiveness to 3-month-old infants during free-play in Japan and in the United States. The researchers found Japanese mothers showed few co-occurring verbal and nonverbal patterns of responses to infant vocalizations. For example, Japanese mothers frequently used gestures alone in response to infant vocalizations. However, American mothers were more often simultaneously expressive (i.e., smiled, exaggerated expressions, raised eyebrows, etc.) and vocal than Japanese mothers in response to infant vocalizations. In research conducted by Hsu and Fogel (2003), maternal responses to infant nondistress vocalizations were examined. In this longitudinal study of American infants during their first 6 months of life, the researchers examined changes in maternal

behavior within face-to-face interactions in a laboratory playroom. They measured when a mother added a new action, stopped an action, or changed the form or intensity of her behavior in response to an infant vocalization. Hsu and Fogel (2003) found that infants' nondistress vocalizations elicited maternal utterances at a response rate of 73%, whereas nondistress vocalizations elicited nonverbal actions at a response rate of only 28%. When mothers responded nonverbally, they responded by touching the infant and producing facial expressions more frequently than by shaking or nodding their heads. Therefore, maternal responses to infant vocalizations were both verbal and nonverbal in nature. These early interactions may help infants become effective communicators in their culture (Fogel et al., 1988). Social feedback from mothers that combines vocalization and touch is critical in infants' earliest communicative attempts (i.e., vocalizations), as it promotes joint attention and shapes the development of infant vocalizations by regulating emotions and vocalizations (Hsu & Fogel, 2003). Mothers may use both verbal and nonverbal responses simultaneously to maintain an infant's attention and to help infants perceive and recognize maternal attempts to communicate or elicit a response.

Bell and Ainsworth (1972) measured mothers' responses to infants' distress vocalizations (i.e., crying, unhappy noises, and vocal protests) at 3 months of age and again at 6 and 9 months of age in home settings. In response to infant distress vocalizations at all ages, the most common method of maternal intervention was to pick up and hold infants, the most effective way to terminate crying. Other frequent behavioral responses used to discourage crying included vocalizing to infants without

added touch, feeding infants, and approaching or touching infants. Rarely did the mothers offer a toy or remove unpleasant stimuli.

Kochanska and Aksan (2004) found a decrease in maternal responsiveness to infants' physical bids (coughing, sneezing, etc.) from 7 to 15 months; however, no change occurred in response to infants' negative bids (distress, upset, crying) or positive social bids (smiling, vocalizing, etc.). Therefore, mothers' frequency of response was stable for both distress and nondistress vocalizations.

Bornstein, Tamis-LeMonda, Hahn, and Haynes (2008) investigated the characteristics of maternal responses to infant behavior at 10, 14, and 21 months of age in naturalistic home-based play interactions. The researchers coded verbal maternal responsive behaviors (i.e., affirmations, imitations/expansions, descriptions, questions, and play prompts) that occurred within 5 seconds of infant behaviors (i.e., exploration, play, bidding, and vocalizing). If vocalizations co-occurred with other behaviors, vocalizations were coded. Maternal behaviors were considered responsive if they were contingent on the preceding infant behavior and appropriate, positive, and meaningful. Overall, mothers responded contingently to 50%-80% of all infant behaviors. Mothers responded more frequently to infant bids than to infant explorations (e.g., object manipulations), and more frequently to infant explorations than to infant vocalizations. While the frequency of maternal responsiveness to infant vocalization did not change proportionately with infant age, patterns of maternal response types did vary with infant age. For example, mothers' use of imitations/expansions and questions increased with infant age, but play prompts remained relatively stable over time. Changes in

maternal behavior were correlated with mothers' awareness of their infants' ability to communicate and understand, as well as mothers' desire to shape infant development (Bornstein et al., 2008).

In summary, although mothers often responded to their infants' vocalizations with spoken language, they also included nonverbal behaviors in face-to-face interactions.

Effects of Maternal Responsiveness

Bloom (1988) defined maternal responsiveness as looking, smiling, touching, or verbalizing following infant vocalization. Bloom's research found responsiveness both elicited infants' vocal responses and influenced their vocal pattern and quality at 3 months of age. Infant vocalizations were less mature (i.e., vocalic) when maternal interaction turns were completely nonverbal than when turns included maternal utterances. Bloom argued turn-taking and verbal stimulation encouraged mature (i.e., syllabic) infant vocalizations. Other experts agree maternal responsiveness to infant vocalizations may influence behaviors important to mastering speech and language. For example, Gros-Louis et al. (2006) found mothers were more likely to use a multimodal response style following infant vocalization (i.e., vocalizing while simultaneously touching or maintaining eye contact) when infants produced consonant-vowel vocalizations, than when they produced vocalizations consisting only of vowels (Gros-Louis et al., 2006). Because consonant-vowel utterances are more complex and similar to adult speech than vowel-only vocalizations, mothers may have provided social

feedback (i.e., combined verbal and nonverbal responses) that shaped infants' vocal development.

Bornstein and Tamis-LeMonda (1997) examined the longitudinal relationship between maternal responsiveness (to distress and nondistress vocalizations) and cognitive abilities (i.e., attention span and symbolic play) when infants were 5 months old and then again when infants were 13 months old. The results indicated that, in the home setting, maternal responsiveness to infant nondistress vocalizations at 5 months predicted infant attention span and symbolic play at 13 months, both important precursors for language. However, maternal responsiveness to nondistress vocalizations at 13 months was not significantly correlated with attention span and symbolic play. Maternal responses to distress vocalizations did not predict cognitive abilities at either age (Bornstein & Tamis-LeMonda, 1997). Mothers perhaps viewed instances of nondistress infant vocalizations at 5 months as opportunities to scaffold infants' vocal development, but responded to distress vocalizations only with the intent to comfort the infant or terminate the crying behavior (Bell & Ainsworth, 1972; Bornstein & Tamis-LeMonda, 1997).

The give-and-take characteristics of mother-infant interaction may benefit infants' social, language, and/or vocal development. For example, Carpenter, Uebel, and Tomasello (2013) found when experimenters mimicked 18-month old infant behaviors (including, but not limited to infant vocalizations) in a laboratory setting, infants increased infants' prosocial orientation towards others (i.e., willingness to help others). Mimicked infants were more likely to help the experimenter or another adult in a

prompted situation than infants who were not mimicked (Carpenter et al., 2013). Adults' acknowledgement (i.e. mimicking) of infants' behaviors (vocal or non vocal) increased their positive pragmatic participation within social interactions. Similarly, Otomo (2001) conducted a longitudinal study in the home environment during the first 2 years of life and examined maternal responses to infants' vocalizations (i.e., real words, ill-formed words, and other non-word vocalizations). Otomo (2001) found mothers most frequently repeated (i.e., exactly reproduced) infants' words but expanded upon ill-formed words (i.e., correctly reproduced target words). In response to non-word vocalizations, mothers most frequently responded with utterances unrelated to infants' vocalizations. Otomo (2001) suggested mothers' repetition of real words and elaboration of infants' immature vocalizations facilitated infants' lexical development by reinforcing correct productions and providing alternatives to their immature vocalizations. Goldstein and Schwade (2008) found that 9.5-month-old infants, in turn, responded to maternal feedback by adjusting their vocalizations to sound more like their mothers.

Finally, mothers' responsiveness to changes in infant behavior (i.e., vocalizing, bidding to mother, or playing with toys) at 9 and 13 months of age predicted the timing of language milestones, including first imitation, first words, 50 words, word combinations, and talking about the past (Tamis-LeMonda, Bornstein, & Baumwell, 2001). Therefore, maternal responsiveness following infant behaviors positively influenced early language acquisition. Maternal responsiveness, often considered a subtype of maternal sensitivity (i.e., mothers' awareness, interpretation and response to

infants' signals), also predicted social and cognitive development in childhood (Stams, Juffer, & van IJzendoorn, 2002). Ainsworth, Bell, and Stayton (1974) described a sensitive mother as one who was an excellent and detailed informant regarding their infant's behaviors. Sensitive mothers were alert and responsive to infant signals. Infants with sensitive mothers were securely attached to their mothers, which increased emotional development and infant security (Ainsworth et al., 1974). Stams et al. (2002) used the same definition of maternal sensitivity in a longitudinal study that found maternal sensitivity when infants were 6 months old predicted social and cognitive outcomes (i.e., greater behavior control and an easy-going temperament) at 7 years of age in children who were adopted. In combination, these studies showed maternal responsiveness positively impacted infants' speech, language, emotional, social, and cognitive development.

Although Bornstein et al. (2008) found mothers responded more frequently to infant exploration than to infant vocalizations, they only examined infant vocalizations that were positive or neutral in affect (i.e., nondistress vocalizations), and only at three infant ages (i.e., 10, 14, and 21 months). Therefore, in order to gain further insight regarding the role of verbal maternal input in infants' speech and language development, a recent unpublished Master's Thesis project extended the infant age range to 4 months, coded maternal responsive utterances to infant vocalizations (i.e., both distress and nondistress), and condensed the time window for responsiveness to 3 seconds following infant vocalization (Millett, 2013). Millett (2013) found mothers verbally responded to 25% of infant vocalizations within 3 seconds, and that

approximately one-third of maternal utterances that occurred within this time window were contingent and appropriate responsive utterances to infants' vocalizations.

Mothers used similar response types across all ages, with the exception of descriptive utterances, which were used more frequently with older infants, 10-12 months of age, than younger infants (Millett, 2013). However, non-responsive utterances (20%) outnumbered responsive utterances (9%) at younger ages (4-8 months).

Gros-Louis et al. (2006) also examined maternal responsiveness to infant vocalizations from 7 to 10 months of age. However, they defined maternal responsiveness as verbal *and nonverbal* behaviors (i.e., object-related nonvocal, object-related vocal, interactive-nonvocal, interactive-vocal, vocal/verbal) that occurred within 2 seconds of infant distress and nondistress vocalizations (Gros-Louis et al., 2006). They found mothers responded contingently (verbally and nonverbally) to 73% of all distress and nondistress vocalizations (Gros-Louis et al., 2006). Methodological differences between studies (Bornstein et al., 2008; Gros-Louis et al., 2006) could account for discrepancies regarding frequency of maternal responsiveness to infant vocalization.

As compared to verbal responsiveness, maternal nonverbal responsiveness may be equally appropriate and important in shaping infant development through influencing certain infant behaviors (e.g., crying or mature vocalizations). After all, infants' nondistress vocalizations elicited nonverbal responses from mothers 28% of the time (Hsu & Fogel, 2003), and some mothers picked up infants in response to crying with only the intent to initiate physical contact (Bell & Ainsworth, 1972). Gros-Louis et

al. (2006) considered nonverbal object manipulation as responsive to infant vocalizations.

Mothers' verbal utterances not considered responsive, contingent, or appropriate to infant vocalizations may also serve a positive function within mother-infant interactions. For example, utterances that initiate face-to-face games or routines (e.g., peek-a-boo) may increase infants' attention, social bidding, and awareness of the structure of social exchanges (Bigelow & Best, 2013). Additionally, mothers may also follow infant vocalizations with utterances intended to change or redirect infant behavior. These re-directive maternal utterances were referred to as "move-ons" by Otomo (2011) and "influence attempts" by Kochanska and Aksan (2004). In both studies, mothers' use of re-directive utterances increased with infant age (Kochanska & Aksan, 2004; Otomo, 2011). Otomo (2011) found that content-rich move-ons directly increased infants' verbal productions; whereas, Kochanska and Aksan (2004) found influence attempts promoted infant safety as infants become more mobile. Thus in both studies, non-responsive re-directive utterances following infant vocalizations were beneficial.

The present study extended the results of Millett (2013) in two ways: (a) by investigating mothers' nonverbal actions following infant vocalizations, and (b) by reexamining utterances that were previously coded as non-responsive. These extensions will contribute to a greater understanding of mothers' verbal and nonverbal behaviors following infant vocalizations and may provide evidence that mothers neither ignored

nor disregarded infants but that instead, their nonverbal actions and non-responsive utterances served a function within mother-infant interactions.

Research Questions and Hypotheses

This study will address two research questions.

1. What, if any, nonverbal but responsive actions do mothers produce following infant vocalizations?

Hypothesis: If mothers do not verbally respond within 3 seconds of infants' distress and nondistress vocalizations, they will respond nonverbally and contingently instead. The most common responsive action will be *Comfort*, as mothers will frequently respond to distress vocalizations with comforting behavior. This prediction is based on research that found picking up and holding infants was an effective and common way to terminate crying (Bell & Ainsworth, 1972). Next in frequency, mothers will respond to infant vocalizations with *object manipulation* actions (e.g., give infants a toy). This prediction stems from work by Gros-Louis et al. (2006) that showed mothers produced object-related nonvocal behaviors following infant vocalization more frequently than object-related vocal behaviors.

2. When mothers' utterances were considered non-responsive, did they follow regular patterns, and did they serve a purpose?

Hypothesis: Mothers' utterances previously coded as non-responsive (i.e., prompt but unrelated to infant vocalization) will serve a useful function. For example, they will serve to attract infants' attention and encourage infants' participation in games or routines (Bigelow & Best, 2013).

Chapter 2

METHOD

Participants

Participants included thirty-five mother-infant dyads (16 mother-son, 19 mother-daughter) recruited from the local community. All infants were typically developing and fell into one of six age groups: 4, 6, 8, 10, 12, or 14 months. Each age group consisted of six dyads except the 10-month group, which consisted of five dyads. All participants lived in the Midwestern United States and mothers spoke only English. The University of Missouri Institutional Review Board approved this research and the recruitment of human subjects.

Procedure

This study analyzed videotaped data from mother-infant interactions, each approximately 8 minutes in length (range: 5.75-11.08 minutes). Data for this study were initially collected for the purposes of another project; however, the current study used the existing data to analyze mothers' verbal and nonverbal behavior in response to their infants. Mothers and infants were video- and audio-recorded (using the internal-microphone of the camcorder) during seven semi-structured activities that took place in the home environment, as follows:

- 1) *Book reading*: Mothers read a Barney picture book to their infants. The book had one picture and a one-word descriptor per page (e.g., "laughing!").
- 2) *Family photo*: Mothers shared a family photo in a plush photo album with

their infants.

3) *Face-to-face*: Mothers interacted with their infants without toys while seated on the floor, a couch, or chair.

4) *Play with toys*: Mothers interacted with their infants using a standard set of toys (i.e., rattle, container with lid and three balls).

5) *Diaper check*: Mothers performed a diaper check, and diapers were changed as necessary.

6) *Hand movement imitation*: Mothers flexed their fingers and opened and closed their hands to observe infants' reaction to these novel actions.

7) *Pinwheel*: Mothers blew on a pinwheel located out of the infants' reach.

Data from the final three segments described above (diaper check, hand movement imitation, and pinwheel) were not analyzed for this project. During these segments, mothers had received instruction to elicit behaviors or maintain certain positions; therefore, interactions did not occur in a natural way. One dyad in the 12-month group did not participate in the family photo segment.

Coding

All mothers' and infants' utterances were previously transcribed from the video recording for an unpublished Master's thesis project. Mothers' utterances were previously classified into one of six categories: vocalization, gasp, laugh, kiss, sound, or unintelligible (Millett, 2013). Maternal mean length of utterance (MLU) in words and morphemes was calculated. Infant utterances (i.e., vocalizations) were previously classified into one of nine categories: verbalization, vegetative sound, cry, laugh, squeal,

grunt, growl, raspberry, or other. Audible or visible breaths determined boundaries between infant utterances. If infants' utterances lacked perceptible information about breathing, vocalizations were divided by the presence of approximately 1- second of silence. Appendix A lists definitions for categories of maternal utterances and Appendix B lists definitions of infant utterances.

Millett (2013) classified mothers' utterances as either *responsive* to an infant vocalization or *non-responsive*. Responsive utterances were defined as mothers' utterances that: a) occurred within 3 seconds of the onset of an infant vocalization; and b) were both contingently and appropriately related to the infant's vocalization. A 3-second time window was used to define responsive behaviors as acceptably prompt in the Millett (2013) study, as the likelihood of two events being perceived as related is dependent on the initial event and the following event occurring within a brief window of time (Rovee-Collier, 1995). Contingent and appropriate responses were those that were both conceptually dependent on (i.e., referred to) the preceding infant vocalization behavior and meaningful (i.e., relevant) in the context of the interaction (Bornstein et al., 2008). Millett (2013) classified mothers' *verbal* responsive utterances into eight mutually exclusive categories: affirmation, imitation, description, comment, question, prompt, laugh, gasp. Maternal utterances not defined by one of these responsive categories were coded as non-responsive (i.e., they were not contingent on infants' vocalizations). Examples of responsive and non-responsive utterances from Millett (2013) are presented in Appendix C.

The current study further examined maternal utterances classified as non-responsive and also investigated all nonverbal actions that followed infant vocalizations. Figure 1 outlines the variables of this study. Actions potentially co-occurred with previously noted maternal utterances (i.e., responsive and non-responsive) and during instances where no maternal utterances were previously noted within 3 seconds (i.e., during silences). These actions were categorized as responsive or non-responsive. Nonverbal actions were assigned to one of seven exhaustive and mutually exclusive categories (5 responsive and 2 non-responsive).

Maternal responsive nonverbal actions were defined as mothers' actions that (a) occurred within 3 seconds of an infant vocalization onset and, (b) that were both contingent on the infant's vocalization and appropriate to the activity.

Responsive Actions:

- 1) *Object-related*: Mother manipulates, touches, or points to an object following an infant vocalization (e.g., infant vocalizes /ba/ and mother moves a ball closer to the infant).
- 2) *Comfort*: Mother strokes, taps, picks up, or hugs infant after an infant vocalization (e.g., infant cries and mother soothes infant by stroking).
- 3) *Reposition*: Mother repositions infant after infant vocalization (e.g., infant cries and mother uncrosses the infant's legs).
- 4) *Head Nod*: Mother shakes her head yes or no in response to infant vocalization (e.g., infant vocalizes /ba/ and mother nods her head yes).

5) *Increase Proximity*: Mother leans closer or turns toward the infant in response to infant vocalization.

Maternal non-responsive actions were classified into two categories as follows.

Non-responsive Actions:

6) *None*: No change in maternal nonverbal behavior.

7) *Irrelevant*: The mother produces a nonverbal behavior not defined by one of the above five categories (e.g., mother adjusts her own clothing).

Next, maternal utterances that were previously considered non-responsive were further examined and classified. These *non-responsive* utterances (within 3 seconds of infant vocalization) were classified into one of five exhaustive and mutually exclusive categories, as follows.

Non-responsive Utterances:

1) *Game/routine*: Mother engages in a ritualized verbal interaction with her infant (e.g., “peek-a-boo,” “a-boo,” “patty-cake”), or sings a song, often co-occurring with rehearsed movements.

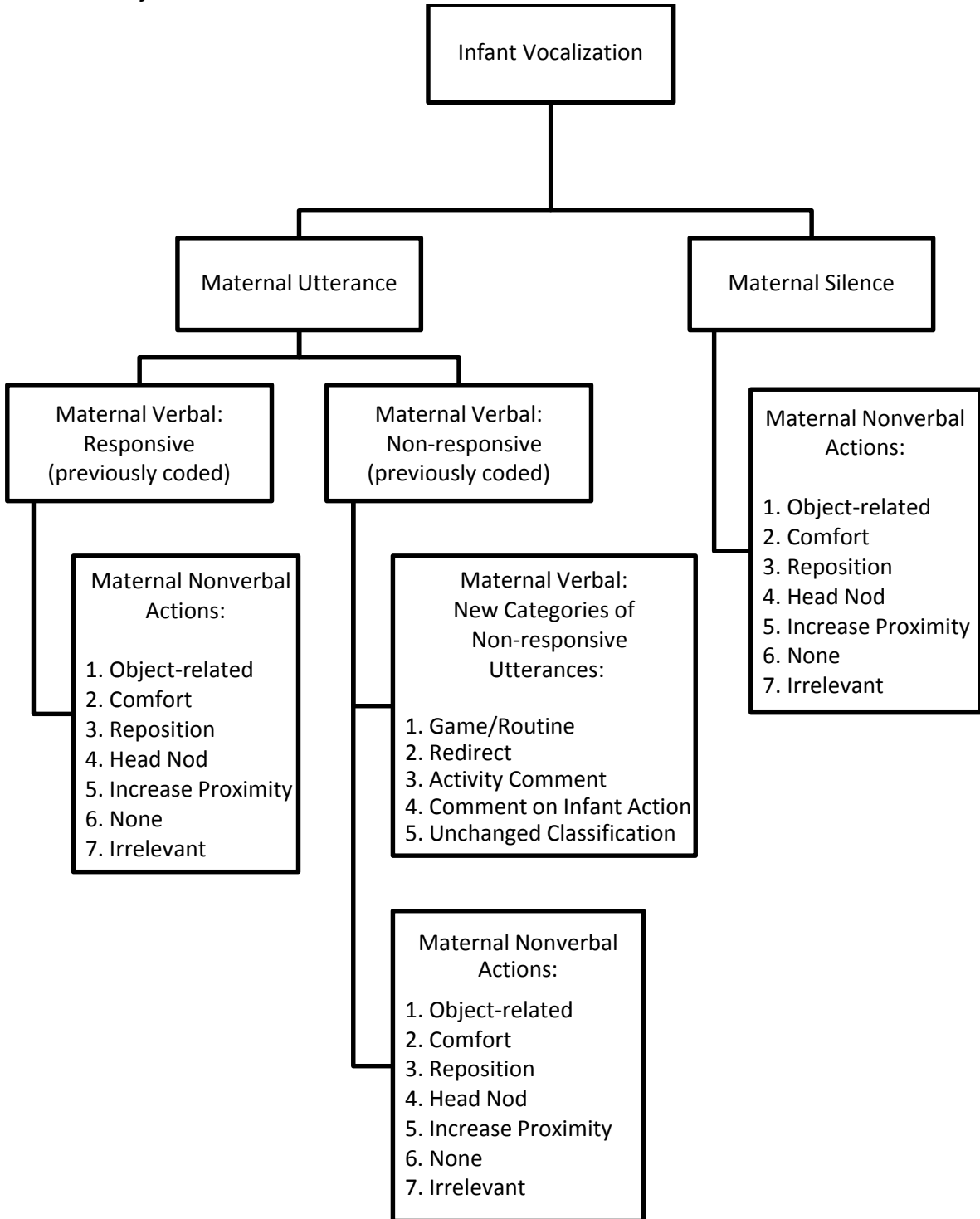
2) *Redirect*: Mother initiates a new topic, introduces a new object, or comments on something unrelated to the object of the infant’s attention and vocalization (e.g., infant looks at and says, “ball,” mother comments, “Look at the Tweetie-Bird.”).

3) *Activity Comment*: Mother comments on a joint ongoing activity (i.e., not infants’ vocalization or action) in order maintain her infant’s attention (e.g., infant cries and mother continues to read).

4) *Comment on New Infant Action*: Mother comments on or narrates infants' movement, independent of the infant's vocalization (e.g., the infant cries and rolls over, mother comments on the action, "rolling over" or "where are you going?").

5) *Unchanged Classification*: Maternal utterances that remained classified as non-responsive and were not defined by one of the above four categories (e.g., infant vocalizes /ba/ and mother comments aloud to herself, "I need to remember to put the laundry in later," or says something to the experimenter).

Figure 1
Flow Chart of Variables



Reliability

Two trained coders independently reviewed 23% ($n=8$) of the mother-infant videos and categorized all maternal non-responsive utterances (e.g., game/routine, redirect, unchanged classification) and all maternal actions (e.g., comfort, reposition) that followed infant vocalizations. Maternal actions occurred with maternal responsive utterances, non-responsive utterances, and maternal silences. Reliability for line by line classification of maternal non-responsive utterances was 95.49% for category assignment (i.e., number of categories in agreement/ total non-responsive utterances). For maternal actions following infant vocalizations, inter-rater reliability was 95.04% (i.e., number of categories in agreement/ total number of actions).

Data Analyses

Dependent variables in the cross-sectional data included overall proportions of mothers' responsive utterances, non-responsive utterances, and episodes of silence following infant vocalizations. Within each of these three major categories (i.e., verbal response types), dependent variables included proportions of co-occurring action types (i.e., head nod, comfort, object-related, reposition, increase proximity, irrelevant, and none). Within the maternal non-responsive utterance category, dependent variables also included proportions of each classification type: activity comment, game/routine, redirect, comment on new infant action, or unchanged classification.

Chapter 3

RESULTS

Descriptive Results

Maternal Verbal Response Types Following Infant Vocalization

Millett (2013) found mothers produced an utterance within 3 seconds following 25% of infant vocalizations. Of the utterances that occurred within the 3-second time frame, approximately one-third were categorized as responsive utterances. This study investigated maternal utterances that were considered non-responsive utterances as well as all maternal nonverbal actions occurring within this time frame.

Results indicated, of all verbal response types following infant vocalizations ($n=1581$ maternal behaviors), 33% were responsive utterances (e.g., previously coded imitations, affirmations, comments; Millett, 2013), 53% were non-responsive utterances (i.e., not contingent on the infant's vocalization), and 14% were instances of silence. Table 1 lists the percentages of each maternal verbal response type by category and infant age.

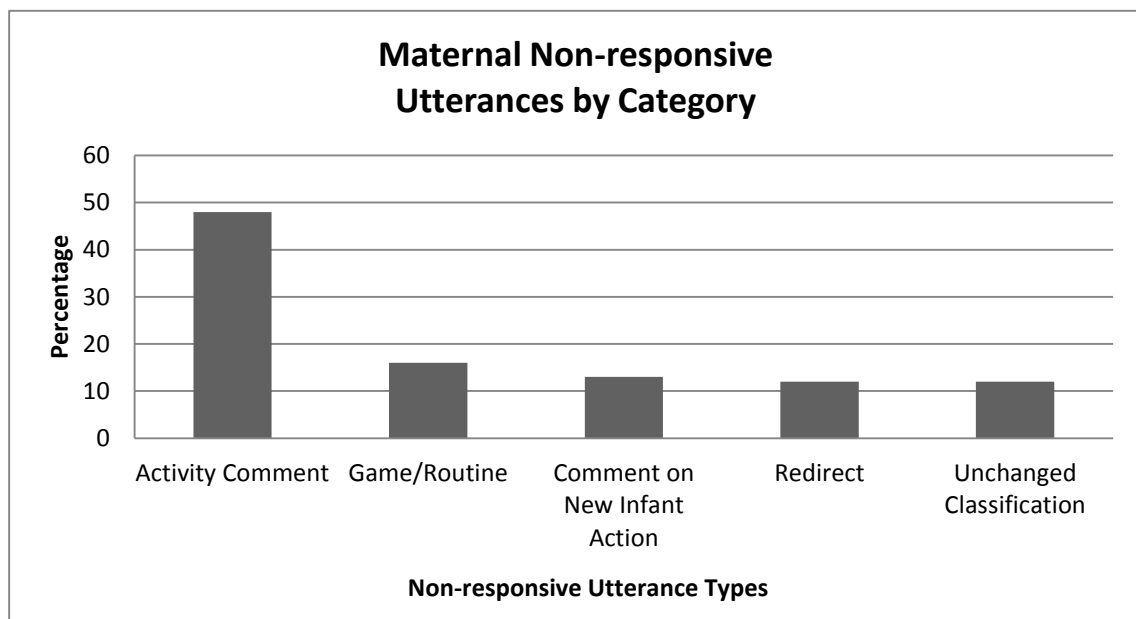
Table 1
 Percentage of Maternal Verbal Response Types after Infant Vocalization by Category and Infant Age

Age	Non-responsive Utterances	Responsive Utterances	Maternal Silences
4	55%	35%	9%
6	62%	22%	17%
8	67%	19%	14%
10	50%	36%	14%
12	41%	44%	15%
14	43%	40%	16%
Mean	53%	33%	14%

Maternal Non-responsive Utterances

The next data show the nature of maternal non-responsive utterances. Figure 2 shows mean percent of maternal non-responsive utterances by category.

Figure 2



As shown in Figure 2, when mothers did not respond contingently to their infants' vocalizations, non-responsive utterances were overwhelmingly activity-related

comments (48%). Although these comments were not directly related to specific infant vocalizations, they were at least appropriate within the mother-infant interaction. For example, one infant vocalized, “ee!” in excitement (about a page in a book), and the mother responded by reading the next page, thereby continuing the activity. The next most frequent non-responsive utterance category was game/routine (16%). Mothers less frequently commented on new infant actions (13%), redirected infants (12%), or produced a non-responsive utterance that did not fall into one of the other categories (12%). Table 1 in Appendix F lists the percentages of maternal non-responsive utterances by category and infant age. As shown in Table 1 of Appendix F, mothers used redirecting utterances more often with older infants than with younger infants (e.g., infant said, “ball,” and mother said, “Look at this picture of your grandma!”). Notably, at 14 months of age, maternal redirects increased by 10% to 20% compared to other age groups. Mothers may have redirected infants more at 14 months due to their increased mobility in order to encourage on-task behavior.

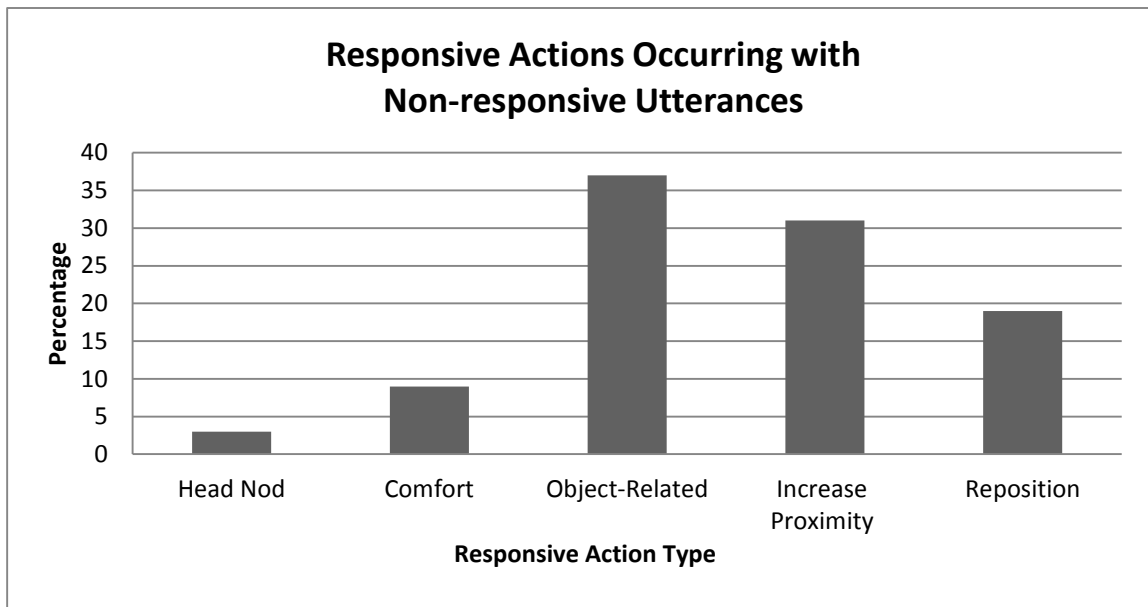
Maternal Actions: Occurrence with Non-responsive Utterances

The next data set involves maternal actions that co-occurred with non-responsive utterances. When mothers produced non-responsive utterances (i.e., utterances unrelated to infant vocalizations), 73% of accompanying actions were either irrelevant (51%; e.g., mother fixing her shirt) or static (22%; e.g., no change in nonverbal behavior, absence of any movement). Therefore, when mothers produced non-responsive utterances, only 27% of their co-occurring actions were considered

responsive actions. That is, while their utterances were not responsive to infant vocalizations, their actions were.

Figure 3 depicts the five responsive action categories (excluding irrelevant and static) that occurred with non-responsive utterances. Each responsive action category is shown as a percentage of all responsive actions that occurred with non-responsive utterances.

Figure 3



As shown in Figure 3, mothers frequently produced object-related responsive actions with non-responsive utterances (37%; e.g., infant said, “ba,” mother responded, “You are so cute when you smile,” handing the infant a ball). Mothers also frequently increased their proximity to infants (31%; e.g., infant said, “ma,” mother continued to read a book but leaned toward the infant), or repositioned infants (19%). Mothers rarely nodded their heads (3%) or comforted/soothed infants (9%) in conjunction with non-

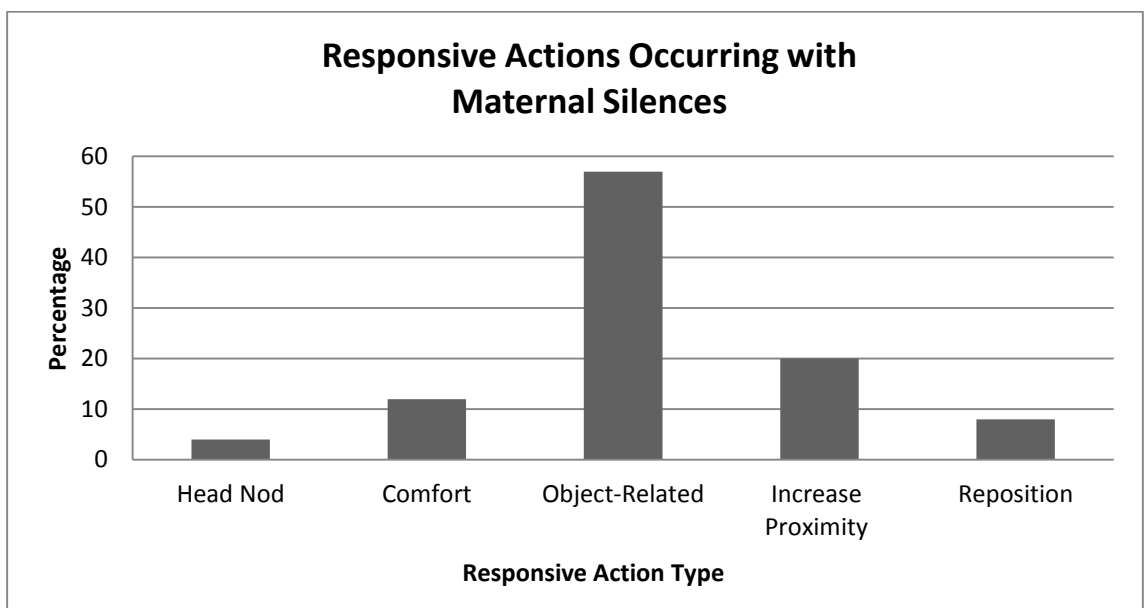
responsive utterances. Table 2 in Appendix F lists the percentages of all maternal actions occurring with non-responsive utterances by category and infant age.

Maternal Actions: Occurrence with Maternal Silences

The next data set addresses maternal actions that co-occurred with maternal silences. When mothers were silent following an infant vocalization, 35% of their actions were irrelevant (e.g., scratching her nose), 34% were static (showed either no change in nonverbal behavior or the absence of any action), and 31% of were responsive and relevant actions (i.e., head nod, comfort, object-related, increase proximity, and reposition).

Figure 4 displays the five responsive action categories (excluding irrelevant and static) that occurred with during silences. Each responsive action category is shown as a percentage of all responsive actions that occurred with maternal silences.

Figure 4

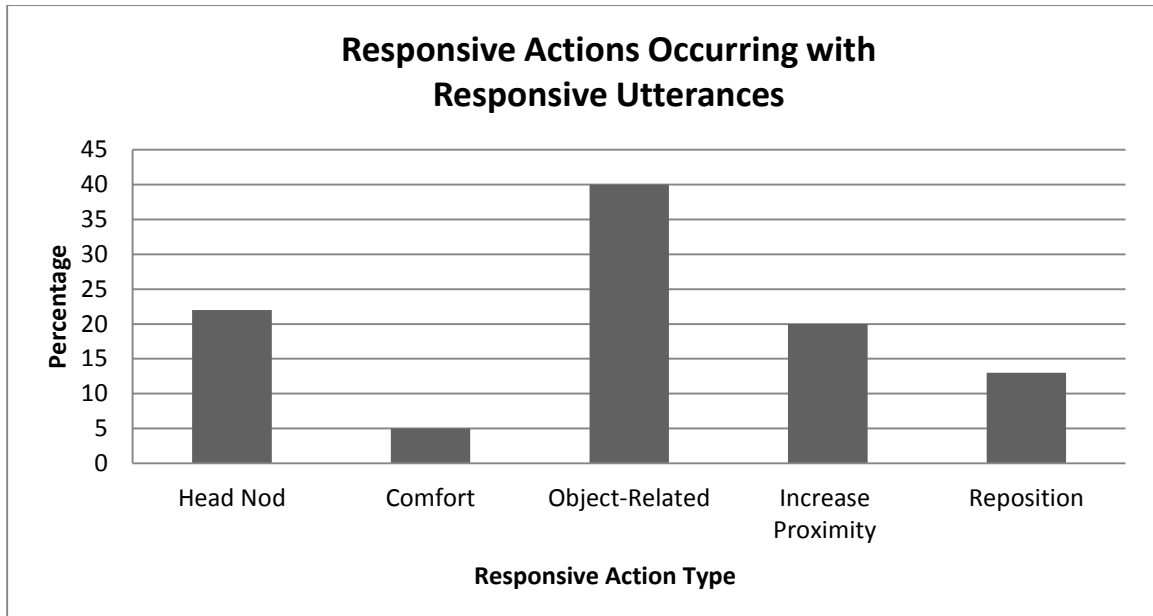


As shown in Figure 4, when mothers were silent following infant vocalizations, they most frequently manipulated or referred to objects to respond contingently to their infants' vocalizations (57%; e.g., infant said, "dada," looking at a family picture, mother remained silent but pointed to the dad in the photo). All other behaviors were relatively infrequent, suggesting most silences (69%) following infant vocalizations were pauses in interactions; however, mothers used responsive nonverbal actions alone in response to 31% of their infants' vocalizations. Table 3 in Appendix F lists the percentages of all maternal actions occurring with maternal silences by category and infant age.

Maternal Actions: Occurrence with Responsive Utterances

The next data set describes maternal actions that co-occurred with responsive utterances (previously coded utterances). When mothers produced responsive utterances (i.e., utterances contingent on an infant vocalization), 58% of their accompanying actions were either irrelevant (27%; e.g., shifting her weight) or static (31%; e.g., no change in nonverbal behavior, absence of any movement). Therefore, 42% of responsive utterances were accompanied by responsive and relevant actions (i.e., actions related to infants' vocalizations). Figure 5 depicts each responsive action type (i.e., head nod, comfort, object-related, increase proximity, and reposition) as a percentage of all responsive actions that occurred with responsive utterances.

Figure 5



When responsive actions co-occurred with responsive utterances they were frequently object-related actions (40%; e.g., infant said, “ba,” mother responded, “That is a ball!” while pointing to the ball). Mothers also nodded their heads (22%) or increased their proximity (20%). Mothers rarely repositioned infants (13%) or comforted infants (5%) while producing responsive utterances. Table 4 in Appendix F lists the percentages of all maternal actions occurring with responsive utterances by category and infant age.

In summary, mothers combined responsive actions with responsive or non-responsive utterances more often than with silences. For example, head nods comprised a larger percentage of responsive actions with responsive utterances (22%) than they did with maternal silences (4%). Thus, mothers nodded or shook their head when verbally responding to infant vocalizations but rarely nodded or shook their head when silent.

Overall, object-related actions were the most frequent responsive actions to occur across all verbal response types combined (i.e., responsive utterances, non-responsive utterances, and maternal silence). Across all verbal response types, 43% of responsive actions were object-related, 26% involved increased proximity, 14% were repositioning, 10% were head nods, and 7% were comfort behaviors. Within each separate verbal response type, object-related actions occurred more frequently than any of the other responsive action types (i.e., 40% of actions with responsive utterances, 37% with non-responsive utterances, and 57% with maternal silences).

Infant-Father Dyad

A single infant-father dyad was coded but not included in the data. The infant was 10 months of age. Table 2 provides frequencies for each action by paternal verbal response type (i.e., responsive utterances, RU; non-responsive utterances, NRU; and paternal silences).

Table 2
Frequency of Father’s Actions Occurring with Various Verbal Response Types

Verbal Response Type	Head nod	Comfort	Object-Related	Prox	Rep	Irr	None	Total
RU	1	0	2	1	2	3	5	14
NRU	0	0	12	0	4	12	6	34
Silence	0	0	0	0	0	1	1	2
Total	1	0	14	1	6	16	12	n= 50

Note. RU = Responsive Utterance, NRU = Non-responsive Utterance, Prox = Increase Proximity, Rep = Reposition, Irr = Irrelevant.

Visual inspection of the data suggested this father produced more non-responsive utterances than responsive utterances or episodes of silence following infant vocalization. This is consistent with data from maternal verbal response types, as the

majority of maternal verbal response types following infant vocalization were also non-responsive utterances. Of this father's non-responsive utterances ($n=34$), most (53%) were activity comments (not shown); activity comments were also the most common non-responsive utterance type for mothers (48%). However, 18% of this father's non-responsive utterances were redirects, 15% were comments on new infant actions, 6% were games/routines, and 9% could not be classified by one of these categories. These data are slightly different from maternal data as mothers produced more non-responsive game/routine utterances (16%) than non-responsive redirecting utterances (12%).

Similar to mothers, the majority of this father's actions (Table 2) were either irrelevant (e.g., scratching his head) or static (e.g., no change in nonverbal behavior, absence of any movement). Of his relevant actions, object-related actions were the most common actions, as was true for mothers. However, his second most frequent responsive action was repositioning the infant, which was unexpected, as mothers infrequently repositioned infants. More data are needed to compare paternal behaviors to maternal behaviors.

Statistical Analyses

Analyses of the cross-sectional data focused on proportions of maternal Verbal Response Types (i.e., responsive, non-responsive, and silence), types of maternal Non-responsive utterances (i.e., game, redirect, etc.), and numbers of maternal Nonverbal Actions (i.e., object-related, comfort, head nod, etc.). Independent variables included

infant age and gender. Analyses were conducted following arcsine transformation of proportional data.

Results of a preliminary repeated measures (Response Types) Analysis of Variance (ANOVA) with infant Gender as the between groups variable indicated proportions of maternal Verbal Response Types did not differ significantly by Gender, $F(1, 33) = 2.74, p = .10$. Mean proportions of maternal Actions also did not differ significantly by infant Gender, $F(1, 33) = .85, p = .36$. Therefore, data were collapsed across gender for additional analyses.

An Age x Maternal Verbal Response Type repeated measures ANOVA revealed a significant Age x Verbal Response Type, $F(10, 58) = 2.63, p < .05$. Planned contrasts for Verbal Response Type indicated Non-responsive utterances ($M = 0.53, SD = .15$) occurred in significantly greater proportions than either Responsive utterances ($M = 0.33, SD = .15, F(1, 29) = 21.43, p < .001$), or Maternal Silences ($M = 0.14, SD = .09, F(1, 29) = 125.66, p < .001$). In a simplified follow up of the Age x Verbal Response Type interaction, Pearson's correlations (two-tailed) showed infant age was significantly positively correlated with proportions of Responsive utterances, $r = .34, p < .05$, and negatively correlated with Non-responsive utterances, $r = -.42, p < .05$; however, infant age was not significantly correlated with maternal silence, $r = .16, p = .34$. Therefore, mothers' responsive utterances increased with infant age and non-responsive utterances declined.

Within the maternal Non-Responsive Category, a one-way repeated measures ANOVA revealed a significant overall effect of maternal utterance type, $F(3, 102) =$

39.95, $p < .001$, with planned contrasts indicating maternal Activity Comments significantly outnumbered each of the other three non-responsive utterance types: Comments on New Infant Actions, $F(1, 34) = 74.59, p < .001$, Game/routines, $F(1, 34) = 45.69, p < .001$, and Redirects, $F(1, 34) = 83.95, p < .001$. Within the Non-responsive category, infant age was significantly positively correlated with occurrence of Redirective utterances ($r = .39, p < .05$) and significantly negatively correlated with Activity Comments ($r = -.43, p < .01$).

An infant Age x Maternal Action Type repeated measures ANOVA indicated the Age x Action interaction was not significant, $F(20,116) = 0.45, p = .97$. The main effect of Age was also not significant, $F(5,29) = 0.97, p = .45$; however, the main effect of Action Type was significant, $F(4, 116) = 15.70, p < .001$. A follow-up repeated measures ANOVA for Action Type revealed object-related maternal actions significantly outnumbered all other action types: comfort, $F(1, 34) = 37.09, p < .001$, head nod, $F(1, 34) = 25.60, p < .001$, proximity, $F(1, 34) = 6.05, p < .05$, and reposition, $F(1, 34) = 18.81, p < .001$.

Chapter 4

DISCUSSION

This study extended research that investigated maternal utterances following infant vocalizations between 4 and 14 months of age (Millett, 2013). Millett found mothers produced verbal utterances following 25% of infant vocalizations. Of these maternal utterances that occurred within 3 seconds, approximately one-third were considered responsive utterances. The current study investigated the nature of maternal utterances that had been classified as non-responsive to infant vocalizations. Non-responsive utterances were defined as utterances that were not contingent upon or related to the immediately preceding infant vocalization. Additionally, this study examined the co-occurrence of maternal actions including nonverbal actions that were related to and contingent upon immediately preceding infant vocalizations, and irrelevant or non-existent actions. These actions could occur in conjunction with maternal responsive utterances, maternal non-responsive utterances, or maternal silences. Here, key findings, limitations, and future research from the current study are summarized.

Non-responsive Utterances

More than half (53%) of maternal verbal response types in this study were classified as non-responsive to infant vocalizations. Of these non-responsive verbal utterances, 89% were, nevertheless, arguably meaningful within the interaction and fell into one of five categories: activity comment, game/routine, comment on new infant

action, and redirect. Therefore, while mothers' utterances were often not by definition related to infant vocalizations, they were frequently appropriate within and related to the context of the interaction. For example, mothers frequently commented on an ongoing activity. Mothers may have narrated activities in order to maintain infants' attention or to highlight relevant aspects of the interaction. In a previous study of maternal responsiveness, Gros-Louis et al. (2006) also found mothers were frequently non-responsive (34% of responses) to infant vocalizations.

Maternal Actions

The present study also examined nonverbal actions occurring with all maternal verbal behaviors and silences. As a group, mothers varied in their tendency to employ responsive actions (i.e., head nod, comfort, object-related, increase proximity, and reposition). Mothers performed more responsive actions in conjunction with verbal utterances (responsive and non-responsive utterances) than they did with maternal silences. Maternal silence was the category least likely to elicit action responses that were contingent on infants' vocalizations. Similarly, Hsu and Fogel (2003) found mothers were more likely to produce actions (e.g., facial expression, touch) in conjunction with utterances that followed infant nondistress vocalizations than they were to produce actions in conjunction with silence.

Within each of the three verbal response types (i.e., maternal responsive utterances, maternal non-responsive utterances, and maternal silences), object-related actions were the most common responsive actions (i.e., 40%, 37%, and 57% respectively). Gros-Louis et al. (2006) also found object-related nonvocal responses

were more frequent (13%) than nonvocal interactive responses that did not involve objects (5%; e.g., picking up, holding, or touching infants). Mothers may facilitate language development in this way by drawing infants' attention to a specific object within the interaction or engaging their infants in play. Within the present study, mothers' object-related behaviors could often be considered repetitive motor movements (e.g., turning a page, shaking a rattle, squeezing a ball). Interestingly, Brand and Shallcross (2008) found infants preferred infant-directed repetitive actions as opposed to adult-directed actions. Thus, infant-directed actions may facilitate infant attention and learning.

Mothers also acted to increase proximity (31%) and reposition infants (19%) in conjunction with non-responsive utterances. However, with responsive utterances (rather than non-responsive utterances), increases in proximity were less frequent (20%). Nevertheless, object-related responses were the most common responsive action.

In summary, mothers' nonverbal behavior varied systematically with verbal behavior type. For example, head nods were more than five times more frequent in the responsive utterance category than in either the non-responsive utterance category or the maternal silence category. Similarly, Fusaro, Vallotton, and Harris (2014) found 98% of mothers' head gestures occurred with speech rather than silence. In their study of 14-month-old infants, head nods were most often used to show maternal attentiveness and head shakes (meaning no) were most often used to prohibit infant behavior (Fusaro et al., 2014). Fusaro et al. argued mothers used head movements to reinforce desirable

infant behaviors (e.g., labels, vocalization attempts) and discourage undesirable infant behaviors (e.g., crying). If maternal multimodal, gesture-vocalization responses are effective in influencing infant behavior in the context of dyadic interactions, it is not surprising that head nods occurred less frequently in the non-responsive utterance and silence category types than in the responsive utterance category.

This study also revealed a significant relationship between infant age and maternal non-responsive redirecting utterances, consistent with the results of a study by Kochanska and Aksan (2004). Kochanska and Aksan found the most frequent parental signals toward 7-month-old infants were maternal social interactive bids (attempts to engage the child). However, at 15 months, influence attempts (asking the child to start to stop an activity and cooperate with caregiver instructions) were the most frequent parental bids (Kochanska & Aksan, 2004). Perhaps mothers used influence attempts to redirect the behaviors of older infants due to their infants' increased mobility (Karasik, Tamis-LeMonda, and Adolph, 2011). Karasik et al. found 13-month-old infants elicited differential responses from their mothers based on their mobility status (i.e., stationary versus walking). Mothers produced more action directives when infants were walking as compared to when they were not moving (Karasik et al., 2011). Thus, mothers changed their responsive behaviors to match their infants' abilities.

It is commonly accepted that maternal responsiveness contributes to early language development (Tamis-LeMonda & Kuchirko, 2014). Research suggests parents respond immediately to infant behaviors in order to shape infants' language and word learning (Tamis-LeMonda & Kuchirko, 2014). Gros-Louis et al. (2006) found mothers of

7- to 10-month old infants responded contingently (verbally or nonverbally) to 73% of all infant vocalizations and behaviors. Bornstein et al. (2008) found mothers of 10-, 14-, and 21-month old infants responded verbally to 50-80% of infant non-distress vocalizations. The present study found mothers were only verbally responsive to 33% of infant vocalizations. However, mothers frequently responded with responsive actions, and when mothers produced non-responsive utterances, the majority (89%) were arguably meaningful in the interaction.

Limitations of this study are as follows. First, this study and other studies investigating the nature of maternal responsiveness include the lack of a standard definition for maternal responsiveness. The frequency of maternal responsiveness may be influenced by fewer or narrower categories of behaviors defined as responsive. Second, aspects preceding infant vocalizations within the interactions were not analyzed; therefore, little is known regarding what may have motivated and influenced infants to produce vocalizations. Additionally, more research is needed to compare the responsiveness of mothers and fathers. Preliminary inspection of the data for one father suggested potential differences between these groups.

Millett (2013) contributed to research in the area of maternal responsiveness by: a) expanding the age range to include infants as young as 4 months of age; b) narrowing the definition of responsiveness to include only maternal responses contingent upon infant vocalizations; and c) investigating only maternal verbal behaviors. Millett (2013) found mothers produced utterances following 25% of infant vocalizations, and approximately one-third of these utterances were classified as responsive. The current

study found that mothers' utterances that were unrelated to infants' vocalizations were often appropriate within the mother-infant interaction. Additionally, mothers often responded appropriately to infants' vocalizations with responsive nonverbal actions. In summary, the current study investigating mothers' utterances that were previously defined as non-responsive to infant vocalizations found mothers frequently engaged their infants through otherwise appropriate and relevant verbal and nonverbal means.

Appendix A

Maternal Utterance Categories (Millett, 2013)

Verbalization: Intelligible speech.

Gasp: An audible, quick inhalation.

Laugh: Chuckle or full laughter; typically unarticulated sounds.

Kiss: Kissing sounds either produced with the lips in the direction of the infant or actual kisses given to the infant.

Sound: Non-speech-like sounds or noises (e.g., animal noises).

Unintelligible: An utterance that was fully unintelligible due to noise, overlap, or volume.

Note: Mothers' vegetative sounds (e.g., coughing, throat clearing) were not included.

Appendix B

Infant Vocalization Categories (Millett, 2013)

Verbalization: Speech-like with discernible vowel and consonant sounds.

Vegetative sounds: Digestive and respiratory noises—hiccoughs, burps, coughing, sneezing, throat clearing, swallowing sounds.

Cry: Fussing, whimpering, or full crying sounds with changes in respiration; often with facial expressions of displeasure, fatigue, pain, etc.

Laugh: Chuckle or full laughter; typically unarticulated sounds.

Squeal: A very high-pitched screech without articulation (i.e., unable to classify as consonant or vowel sounds).

Grunt: Sound produced with lips closed or nearly closed, and no articulation. Often heard during reaching or effortful movements.

Growl: Low pitch, glottal sound like growling.

Raspberry: Blowing sounds with lips together or with tongue between lips.

Other: Other rare non-vegetative sounds such as tongue clicks and kissing sounds.

Appendix C

Examples of Mothers' Responsive and Non-responsive Utterances Following Infant

Vocalization (Millett, 2013).

Infant: /ε/

Non-responsive: "Are you kicking?"

Responsive: "You gonna talk to me?"

Infant: /ae/

Non-responsive: "And here we go."

Responsive: "Yeah."

Infant: /du/

Non-responsive: "Andy. Where's the wheels?"

Responsive: "Yeah that's a choo-choo."

Infant: /ba/

Non-responsive: "Where's your nose?"

Responsive: "Is that a ball?"

Infant: /gl/

Non-responsive: "Let's look at this picture."

Responsive: "Yeah!"

Note: Contextual information (not noted here) contributed to determining mothers' responsive vs. non-responsive utterances.

Appendix D

Examples of Maternal Nonverbal Responsive Actions (Within 3 Seconds of the Onset of an Infant Vocalization).

Infant: /ba/	Mother picks up ball and shakes it (<i>Object-Related</i>)
Infant: (<i>grunt</i>)	Mother leans closer to the infant (<i>Increase Proximity</i>)
Infant: (cry)	Mother pats the infant's leg (<i>Comfort</i>)
Infant: (cry)	Mother lays the infant on her back (<i>Reposition</i>)

Appendix E

Examples of Maternal Verbal Non-Responsive Utterances (Within 3 Seconds of the Onset of an Infant Vocalization).

Infant: /ga/	"Yay, we did it!" (<i>Activity Comment</i>)
Infant: (veg)	"Where's Garret? There he is!" (<i>Game/Routine</i>)
Infant: /ae/	"Here's Tweety." (<i>Redirect</i>)
Infant: /u/	"You gon' grab it?" (<i>Comment on New Infant Activity</i>)

Appendix F

Percentages of Maternal Behaviors by Category and Infant Age

Table F1

Percentage of Maternal Non-responsive Utterances by Category and Infant Age

Age	Activity Comment	Game/Routine	CONIA	Redirect	Unchanged Classification
4	58%	5%	12%	9%	16%
6	55%	21%	8%	5%	10%
8	47%	25%	7%	10%	11%
10	46%	14%	14%	15%	11%
12	45%	18%	22%	8%	6%
14	35%	10%	15%	25%	15%
Mean	48%	16%	13%	12%	12%

Note. CONIA = Comment on New Infant Action.

Table F2

Percentage of Maternal Actions Occurring with Non-responsive Utterances by Category and Infant Age

Age	Head Nod	Comfort	Object- Related	Prox	Reposition	Irr	None
4	1%	3%	10%	5%	4%	45%	31%
6	1%	2%	20%	6%	10%	44%	18%
8	1%	1%	7%	9%	4%	65%	12%
10	0%	0%	11%	10%	7%	40%	32%
12	1%	9%	9%	4%	3%	61%	12%
14	1%	1%	10%	9%	6%	48%	26%
Mean	1%	3%	11%	7%	6%	51%	22%

Note. Prox = Increase Proximity; Irr = Irrelevant

Table F3

Percentage of Maternal Actions Occurring with Maternal Silences by Category and Infant Age

Age	Head nod	Comfort	Object-Related	Prox	Reposition	Irr	None
4	0%	0%	19%	6%	3%	40%	32%
6	0%	2%	47%	7%	3%	15%	26%
8	0%	6%	19%	7%	0%	38%	30%
10	0%	2%	0%	0%	2%	41%	55%
12	0%	2%	12%	23%	0%	34%	28%
14	4%	3%	6%	4%	2%	45%	35%
Mean	1%	2%	18%	8%	2%	35%	34%

Note. Prox = Increase Proximity; Irr = Irrelevant.

Table F4

Percentage of Maternal Actions Occurring with a Responsive Utterance by Category and Infant Age

Age	Head nod	Comfort	Object-Related	Prox	Reposition	Irr	None
4	5%	2%	13%	13%	7%	14%	46%
6	6%	9%	21%	10%	6%	25%	22%
8	11%	1%	11%	8%	2%	44%	23%
10	1%	0%	28%	4%	8%	24%	35%
12	7%	6%	27%	7%	1%	32%	20%
14	13%	0%	16%	7%	3%	21%	39%
Mean	8%	3%	19%	8%	4%	27%	31%

Note. Prox = Increase Proximity; Irr = Irrelevant.

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