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Mother-Infant Synchrony during Infant Feeding

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MOTHER-INFANT SYNCHRONY DURING INFANT FEEDING

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

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Dedication

In memory of my mother, Agatha Smith (1923-2009), whose personal experiences with preterm birth and parenting a child with special needs had a profound influence on me. Her unconditional love for her children will always be remembered.

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Abstract

MOTHER-INFANT SYNCHRONY DURING INFANT FEEDING

By Barbara A. Reyna, PhD

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Synchrony between a mother and her infant is fundamental to their relationship. Feeding is an essential activity that provides an opportunity for interaction between a mother and her infant and may lead to synchronous interaction. The purpose this study was to develop and test a coding system, the Maternal-Infant Synchrony Scale (MISS) for assessing synchrony of feeding interaction between a mother and her preterm infant. The secondary aims were to: (1) describe mother and preterm infant synchrony during feeding; (2) examine mother-infant synchrony during feeding over time; (3) examine the mediating effects of infant severity of illness, behavior state, birth gestation and birth weight and maternal depression, and maternal responsiveness and sensitivity on mother-infant synchrony; and (4) test the criterion-related validity of the synchrony scale. A descriptive, longitudinal design using data collected during an early study was employed; a sample dataset from 10 mother-infant dyads that completed three data collection points (30 observations total) were used. Data were also collected on maternal depression and

responsiveness and sensitivity and dyadic tension and reciprocity. For this analysis, scores for infant severity illness and behavior state were computed. The Noldus Observer XT 8.0 (Noldus Information Technology b.v., 2006) was used for data review and coding. The MISS was created by determining the frequency of select behaviors and the percentage of time behaviors occurred during the feeding; changes in behaviors over the three observations periods were calculated. Mothers were attentive and focused during feedings. The influence of infant maturation on feeding behaviors was evident across observations; infant attempts at interaction (gazing at mother) were greater than the mother attempts to engage her infant. MISS scores were not significantly different over the observations, the selected mediators had no significant effect on synchrony and the criterion validity for the MISS was not established. This study revealed behaviors that are descriptive of the interaction and can be used to develop interventions that would support the developing relationship. Use of the MISS with a larger sample size and a cohort of healthy, term newborns is needed to establish the MISS as a valid and reliable measure of synchrony.

CHAPTER 1

Mother Infant Synchrony

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Mother-Infant Synchrony

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ABSTRACT

Synchrony is an essential component of the interaction between a mother and her infant and is characterized by adaptive and reciprocal behaviors that promote a mutually rewarding interaction. It is an antecedent for the emergence of self-regulatory function in infants and influences current and future interactions. Understanding the dynamics of the mother-infant dyad and identifying synchronous patterns are important for promoting a healthy relationship. Approaches to measurement and challenges to model development are described.

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Synchrony is an essential component of the interaction between a mother and her infant and is fundamental to the attachment relationship. Multiple constructs related to mother-infant synchrony have been defined in the literature that involve the interaction between a mother and her infant and include some form of mutual responsiveness. Synchrony is a dyadic interaction that provides for an observable pattern that is mutually regulated, harmonious, and reciprocal. Observing the patterns of dyadic interactions can provide insight into the social relationship of the mother and infant (Harrist & Waugh, 2002).

Although the structure and function of synchrony changes from early infancy through childhood, the ability to achieve synchrony may represent a crucial developmental achievement for dyadic relationships thereby facilitating social, emotional, and cognitive growth (Harrist & Waugh, 2002). In addition, synchrony is considered an antecedent to the development of self-control and other self-regulatory behaviors in infants and children (Feldman & Eidelman, 2004; Feldman, Greenbaum, & Yirmiya, 1999). This article explores the meaning of mother-infant synchrony within the theoretical framework of attachment and describes several methods for its measurement.

In describing synchrony, the emphasis is on the mother-infant dyad as an interactive system. How this system functions is influenced by the unique characteristics of the mother and infant and how each modifies behavior in response to the other. A positive synchronous interaction is characterized as being adaptive, reciprocal, and flexible. Moreover, there is rhythmicity to the interaction as each member makes behavioral adjustments in order to maintain balance in the system (Barnard, 1987).

Inherent in this interaction is a rhythmic attention-withdrawal pattern that occurs as the mother regulates her level of attention in response to changes in her infant's behaviors (Brazelton, Koslowski & Main, 1974). Similarly, interactional synchrony identifies specific associations between interaction and attachment. It is the extent to which an interaction appears to be reciprocal and mutually rewarding between an infant and mother (Isabella, Belsky, & von Eye, 1989). The interaction that occurs between a mother and infant has also been described as a "behavioral dialogue." The conversation involves a variety of communicative behaviors that change with the developmental level of the infant and include vocalizations and visual regard (Bakeman & Brown, 1977; Brown & Bakeman, 1980). Simply stated, the essence of synchrony can be considered as, "the sustained nonrandom co-occurrence of two behavioral phenomenon" (Bernieri, Reznick, & Rosenthal, 1988, p. 244).

Mother-infant interaction is described within an adaptive framework using Erik Erikson's model of personality development (Sander, 1964). The active tendencies of the mother and infant adapt or conform to each other. The coming together of these active tendencies culminates in a reciprocal quality that signifies the achievement of harmony in the interaction. As the infant grows older and advances to the next developmental stage, a new level of har-

mony in the reciprocal interaction must be achieved. The experience gained from the previous levels provides the foundation for the achievement of the next level of interaction. The coordinated interaction between the mother and infant is maintained by the opportunities each have to adjust to the other (Sander). In addition, these opportunities for dyadic interaction shape the child's emerging self-organization skills and personality development that impact future relationships. Thus, previous relationships influence current and future relationships (Sroufe & Fleeson, 1986).

Theoretical Framework

Attachment theory provides the foundation for the concept of maternal-infant synchrony. The theoretical developments of John Bowlby demonstrated the importance of mother-infant attachment. Bowlby's theory of attachment, which has its foundation in control systems theory and the principles of psychoanalysis and ethnology, has been studied, modified, and expanded over the years. Bowlby emphasized that real-life events were of key importance in determining development. His belief that a primary attachment bond between mother and child was "wired in" from birth or biological was revolutionary for its time (Bowlby, 1982; Holmes, 1995).

Bowlby recognized the contribution of the infant to developing mother-infant attachment. He hypothesized that basic infant behavior such as sucking, crying, and smiling act as stimuli that induce the mother to respond. The pattern of her responses shapes the infant's behavioral systems into an integrated response (Bowlby, 1982). In other words, early attachment is dependent on the mother anticipating her infant's needs and recognizing her infant's cues. The pattern of interaction developed during this period is part of the procedural or implicit memory in the infant. This learning occurs before the ability for conscious recall but plays a role in shaping future interactions. Thus, the repeated experiences stored as part of the procedural memory lead to the infant's feelings of security (Kandel, 1999; Maunder & Hunter, 2001).

Kraemer (1992) further described the role neurobiology plays in attachment. Through his work with rhesus monkeys, he proposed that neurochemical differences result when there is maternal deprivation and repeated exposure to the stress that results. The behaviors that promote regulation in the infant and motivate a mother to respond are genetically encoded. Thus, there is a genetic basis for the internal regulatory mechanisms that are further shaped by the mother through repeated interaction (Kraemer). Attachment therefore encompasses many systems, behavioral, physiological, and biological, that work together to regulate and maintain a social relationship. When the mother-infant attachment process is altered, the development of these systems and how they interact can be affected, leaving the infant more vulnerable and potentially shaping later development (Hofer, 2006).

A positive synchronous interaction is theoretically characterized as adaptive, reciprocal, and flexible.

Ainsworth and Marvin (1995) elaborated on Bowlby's core concept that an infant uses its mother as a secure base from which to explore the world. By observing mothers and their infants, they described how infants and children develop different patterns of relationships during particular experiences using the mother as a secure base. This secure-base behavior is reflective of the effectiveness of the attachment as a source of security for the infant. The child is able to use the secure base in order to explore their environment but return to the "safe" base in times of stress. Parents who are emotionally available, perceptive, and responsive to their infants' needs and cues have infants who are most often securely attached (Ainsworth & Marvin).

Attachment theory proposes that at the most fundamental level there is a biological basis for attachment that determines the emergence and general shape of the behavioral organization. The environment does not play a significant role in the infant's basic need for an attachment figure that can be trusted. However, cultural differences and child-rearing practices, such as proximity-seeking behaviors and the mother's response to her infant, can affect certain aspects of attachment (Bialoskurski, Cox, & Hayes, 1999). When and how a mother determines it is time to foster her child's independence and not respond immediately to her child's behaviors can either foster a secure attachment or contribute to a pattern of insecurity (Ainsworth & Marvin, 1995).

An antecedent to mother-infant attachment is maternal sensitivity. The pioneering work done by Ainsworth and Marvin identified the role of maternal sensitivity in developing secure infant attachment behaviors. This sensitivity promotes

Attachment theory provides the theoretical foundation for the concept of maternal-infant synchrony.

synchronous, reciprocal, and jointly satisfying mother-infant interactions. In turn, these interactions foster the development of a secure attachment relationship (Hane, Feldstein, & Dernetz, 2003; Koren-Karie, Oppenheim, Dolev, Sher, & Etzion-Carasso, 2002).

The work of Brazelton and Als (1979) further elaborated on the dyadic nature of the mother-infant interaction. Their work supported Bowlby's theory that the infant is an active participant in the interaction, and they suggested that the earliest observable behavior of mothers and infants could provide insight into the influence each member of the dyad has on the other. Their model proposed a parent-infant feedback system that is constantly adapting to stress and change with a built-in self-regulatory goal. The infant is equipped with primitive reflex behavioral responses at birth. These responses soon develop into more complex patterns of behavior that help achieve the infant's need for organization at a time when he or she is still prone to disorganization of neuromotor and physiological systems. The infant has the capacity to shut out or tune into the environment. How the infant responds to the environment will affect how the mother responds to the infant and will subsequently influence the mother's behavior in future interactions (Brazelton & Als). Thus, early mother-infant interaction is a time for the infant to learn how to control the physiological demands of the interaction and attend for longer periods of time. This process is modulated by the mother's sensitivity to her infant's cues. The rhythmic interdependency is the foundation of their attachment and represents communication between the dyad (Brazelton et al., 1974).

Internal Working Models

An integral component of the attachment theory is internal working models. A working model is an intrinsic or mental representation developed from attachment-related experiences that regulate thoughts and actions (Pridham, Saxe, & Limbo, 2004). From repeated interactions with the environment, a child constructs increasingly complex, internal working models that include themselves and significant persons. These internal working models operate outside conscious awareness and can be difficult to alter but are subject to revision over time (Bretherton, 1985). Working models help regulate thought and action by providing a map of previous experiences with which to interpret current experiences, anticipate and explain future interactions, and develop strategies to respond. Through the development of working models, the child can anticipate the attachment figure's likely behavior, plan his or her own responses, and thus develop a personal internal working model (Bretherton, 1995).

Internal working models are constructed of dyadic experiences between the infant and the figure of attachment. These models develop over time and with experience and can be redefined and influenced through experience and from interactions with others. In early development, the working models for the infant and figure of attachment are closely interrelated and may be better represented as an internal working model of the relationship. Cognitively, the infant is unable to separate self from others. However, as the infant develops cognitive abilities through childhood, the working model becomes more distinct and individualized (Main, Kaplan, & Cassidy, 1985). Reciprocal and positive interactions promote the development of the infant's working model of mother as available and trustworthy (Isabella et al., 1989).

Several working models have been developed to describe the mother-infant relationship from the mother's perspective, and they guide the mother as she makes decisions regarding her infant. A working model of caregiving involves thinking about caring for the infant, reflecting on what is happening and why, and considering the infant's perspective. It involves adapting and integrating the infant's expectations with the mother's own (Pridham, Schroeder, & Brown, 1999). A mother's working model of feeding involves her motivations, feelings, and thoughts about feeding. The working model operates actively during a feeding and is likely to be in a mother's conscious awareness whenever a challenge to feeding goals is encountered (Pridham et al., 2004).

Part of the working model of mother's feeding is the working model of coregulation. This model is based on whether the mother views feeding as an outcome she can influence, the value placed on her infant's participation in the feeding (engagement), and how she views her role in supporting her infant's feeding skills. Infant engagement is coregulated by the mother and the infant throughout the feeding (Thoyre & Brown, 2004). Lastly, the effect of attunement on a mother's working model of feeding is expressed in her attempts to understand the feeding experience through reflection on her infant's wants and preferences and how she decides

to be supportive of those needs. A mother attuned to the feeding experience considers her infant's nutrition as well as their developing relationship within the context of feeding (Pridham, Schroeder, Brown, & Clark, 2001).

Working models are important in understanding how a mother thinks and feels about caring for her infant. The working models used by the mother can affect the infant's health, growth, and development (Pridham et al., 2001). In addition, because working models guide maternal behavior, mother-infant synchrony may be a measurable outcome of these representations. The mother's working models can help understand the observed behavior and facilitate the development of interventions that can best support the dyadic relationship.

Measurement

The measurement of synchrony involves examining an interaction between a mother and her infant for behaviors or elements and analyzing their pattern. Early research with limited technology identified predetermined behaviors by dividing a mother-infant observation into brief units of time, typically measured in seconds. Using direct observation, data were collected using a checklist for behaviors. Some studies used continuous video recording of an interaction with a stop-frame projector to analyze each frame and record behaviors on a running record sheet. This allowed for simultaneous recording of all behaviors for both members of the dyad. Current computer technology allows for continuous coding of variables for each member of the dyad, thus describing in detail interactive events. Software programs can provide graphic display over time of the interactional patterns and compile frequency and duration data (Stephenson, Pridham, & Mlynarczyk, 1996). Regardless of the technology, once the behaviors are identified and coded, the frequency, duration, sequence, and co-occurrence of all behaviors can then examined for the amount of interaction occurring relative to the efforts of both the mother and the infant to interact (Lewis & Lee-Painter, 1974).

Qualitative terms such as synchrony, responsiveness, or reciprocity are often used to characterize mother-infant interactions, which makes it difficult to establish a reliable and valid measure of synchrony. Therefore, the challenge is to find an objective method of measuring synchrony that can be generalized to any mother-infant dyad. The ideal measure should allow for individual differences in the interaction and should not be dependent on the number of interactions (Booth, Lyons, & Barnard, 1984). For example, a dyad in which mother or infant unsuccessfully attempts numerous times to engage the other should be differentiated from a dyad that may have fewer attempts but more successes. In addition, the total pattern of behavior, taking into account whether a behavior is an initiated behavior or a response behavior and determination of those behaviors that occur simultaneously, is important in understanding the dynamics of the mother-infant interaction (Lewis & Lee-Painter, 1974). The method of measurement for mother-infant synchrony should control for any bias on the part of the observer, be grounded in specific behaviors without being dependent on them, and uncover the structure of the interaction that might not be readily evident (Bakeman & Brown, 1977). Therefore, although measuring specific behaviors, the importance is the sequence or pattern of these behaviors and their relationship to each other within the dyadic exchange.

Identifying the occurrence of synchronous interactions and influencing factors is important for developing interventions to promote affective and cognitive development.

A relatively simple method of measuring synchrony involves frequency counts of infant or maternal behaviors. This assumes a causal relationship and provides limited information regarding the interactive quality. Measuring simultaneous behavior of the mother and infant provides stronger support for the level of interaction. From the ratio of total frequency of behavior to simultaneous behavior, a general responsivity score can be obtained, and a matrix of maternal and infant behaviors can be developed. This type of analysis does not account for point of entry and may not account for random simultaneous events.

Some of the earliest work examining synchrony in mother-infant interactions was done by Karger (1979). In a study to assess mother-infant interaction, 23 full-term and 26 preterm infants and their mothers were observed during feeding before hospital discharge, at 1 month, and at 3 months using 30 minute bottle-feeding sessions. Each observation was divided into three hundred and sixty 5 second frames. Using 42 mother behaviors and 30 infant behaviors, the session was coded for the following: infant only communicating; mother only communicating; both mother and infant communicating; or no communicative behaviors occurring. The feeding session was then divided into 90 sec-

ond segments, and the correlation between mother and infant communicative behaviors was calculated to determine maternal and infant rates of communicative behavior as a measure of mother-infant synchrony.

From the results, positive pattern and negative synchrony patterns were identified. A positive synchrony pattern was considered optimal, showed a positive correlation between mother and infant behavioral rates, and demonstrated adjustments in the mother's behavior in response to changing infant behaviors. A negative synchrony pattern showed a negative correlation between mother and infant behavioral rates and represented a less than optimal synchrony pattern. Thus, the negative pattern demonstrated less infant communicative behaviors and fewer attempts by the mother to communicate with her infant (Karger, 1979). Karger's method of calculating synchrony used a sum of the number of times a type of interaction occurred within a segment. Therefore, it did not differentiate how successful the mother and infant were in actually engaging each other.

A similar method of analysis was used by Brown and Bakeman (1980) to examine the effect of prematurity on mother-infant interaction. They viewed mother-infant interaction as consisting of a broad range of communicative behaviors that were part of a discourse between the dyad. The analysis involved using similar time segments and behavioral coding to identify four sequences of communication: infant only; mother only; infant and mother; and none. Viewing the interaction in sequences using the four dyadic states allowed for certain characteristics of the interaction to be quantified. Thus, the proportion of time spent in various dyadic states was calculated and the probability with which certain states followed each other was identified (Brown & Bakeman).

Booth et al. (1984) felt that a measure of mother-infant synchrony should provide a good estimate of the "mesh" between mother-infant behavior and truly reflect a characteristic of the dyad as a unit or system rather than as separate measures of maternal responsiveness and infant responsiveness. They identified the ideal measure of synchrony as one that allowed for variability in the number of interactions while recognizing that the number of interactions that occur during an observation can be highly variable. In addition, mutually sensitive dyads can have fewer interactions but demonstrate higher synchrony during the observed exchanges. Their study was a comparison of a duration-based method with the frequency-based measurement method used by Karger (1979).

The frequency-based score involved summing the number of attempts the mother and infant made to engage one another but did not include whether their attempts were successful. A duration-based score accounted for the relative amount of time a mother and infant spent in engagement activities. Therefore, this method was thought to be a more sensitive measure of synchrony because it took into account a dyad that spent a large amount of time interacting relative to the amount of time spent trying to engage each other. However, the results indicated that the frequency-based synchrony measure developed in the study better reflected the dyad as a system and was not dependent on the actual number of interactions. Moreover, the duration measure demonstrated less stability across two observations than the frequency measure. The authors suggested that the duration measure may have been overly sensitive to behavioral changes that fluctuated from day to day. They concluded that the frequency-based measure could be useful as an initial assessment of the mother-infant dyad and as a basic method for calculating synchrony (Booth et al., 1984).

The importance of maternal sensitivity as a component of synchrony is underscored by evidence suggesting a link between parent behavior and infant stress reactivity and regulation. It is suggested that maternal behavior serves a regulatory function for an infant's biological and emotional organization. Heart rate and vagal tone may be useful measures of the physiological effects of dyadic synchrony between mother and infant (Feldman, 2007; Moore & Calkins, 2004). Analysis of heart rate variability (HRV) provides an index of the balance between the sympathetic and the parasympathetic branches of the autonomic nervous system (ANS). Change in the HRV pattern can be an early and sensitive indicator of compromised health. A high amount of variability in the heart rate pattern is a sign of overall good adaptability (Pumprla, Howorka, Groves, Chester, & Nolan, 2002). Infants with higher autonomic maturity have a greater capacity to modulate their behavior during parent-infant interactions and thus demonstrate more synchronous behavior (Feldman, 2006; Feldman & Eidelman, 2007). Similarly, infants of more responsive parents show greater regulation of heart rate and negative affect (Haley & Stansbury, 2003).

In response to an actual or perceived stress, the endocrine system secretes glucocorticoids. These

hormones mediate the stress response and participate in a host of physiological responses (Sapolsky, Romero, & Munck, 2000). Salivary cortisol levels are an indicator of this stress response and have shown to be elevated during periods of autonomic arousal. A cortisol response has been observed in infants of highly insensitive mothers during play interactions (Spangler & Grossmann, 1993; Spangler, Schieche, Ilg, & Maier, 1994). Thus, a mother's attempt to regulate her infant's behavior and respond contingently is important in the development of adequate coping strategies during stressful events.

Other variables that may be indirect measures of dyadic function include maternal factors such as stress, self-esteem, depression, and perceived support (Amankwaa, Pickler, & Boonmee, 2007; Cornish et al., 2006). Infant factors such as prematurity and the effects of the intensive care environment can impact the infant's behavior and influence the dynamics of the mother-infant dyad (Whitfield, 2003). In addition, the development of a chronic illness as a sequelae of prematurity may also effect maternal behavior (Holditch-Davis, Cox, Miles, & Belyea, 2003). The combined effect of maternal and preterm infant characteristics such as severity of illness, infant irritability and maternal stress, education and race can influence the quality of the mother-infant interaction (Holditch-Davis, Schwartz, Black, & Scher, 2007).

The above methods serve to quantify synchrony and provide numerical data that could be developed into a scoring system. The drawback to a scoring system is the sequences of events are not evident. Using a flow model approach to describe the interaction is visually appealing but assumes that the last behavior of one is responsible for the next behavior in the other member of the dyad. Therefore, dyadic nature of the interactions may not be captured (Lewis & Lee-Painter, 1974). Another difficulty with this approach is determining the point of entry of an interaction, the initiator of the interaction and the terminator. Data can be overlooked that would contribute to a richer understanding of the mother-infant interaction. Clearly, the measurements of synchrony described do not take into consideration the mothers' intent and interpretation of the interaction. Interviewing mothers to uncover their internal working models would provide an added dimension to the analysis and provide a more dynamic description of the interaction.

Conclusion

There is growing evidence that adverse events around birth can influence brain development and effect outcomes. The mother has a crucial role in providing the foundation upon which an infant develops self-regulatory skills. Through repeated interactions, the infant learns what to expect in exchanges with others. In addition, when an infant responds as expected the mother learns that what she does is important. This exchange promotes a healthy relationship between a mother and infant and fosters a positive sense of self for the infant. Understanding how these early experiences influence later development may influence care provision for high-risk populations, such as infants who are born preterm. Difficulties with attention regulation do not become apparent until school-age in many of these children. Thus, little attention has been paid to assisting mothers in their efforts to interact in synchronous, developmentally supportive ways with their infants. In addition, the potential for a biopsychosocial model of disease is intriguing. The consequence of insecure attachment and the resulting stress response may have implications for future health and well-being (Anand & Scalzo, 2000; Maunder & Hunter, 2001). Identifying the occurrence of synchronous interactions between a mother and infant and factors influencing this relationship will be important in developing interventions to promote affective and cognitive development.

Measuring and analyzing mother-infant synchrony is a complex task. Individual differences as well as the total pattern of behavior must be accounted for in the analyses. A mother's perception of the interaction with her infant and understanding the internal working models adds another dimension to the analysis that can provide further depth of understanding. Mother-infant interactions are not static and an interactional model for the measurement of synchrony will need to demonstrate the dynamic nature of the relationship and the flow of the interaction over time.

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CHAPTER 2

Research Plan

The following published research plan was submitted to and approved by the Virginia Commonwealth University Institutional Review Board.

VCU RESEARCH PLAN TEMPLATE

Use of this template is required to provide your VCU Research Plan to the IRB. Your responses should be written in terms for the non-scientist to understand. If a detailed research protocol (e.g., sponsor's protocol) exists, you may reference that protocol. NOTE: **If that protocol does not address all of the issues outlined in each Section Heading, you must address the remaining issues in this Plan**. **It is NOT acceptable to reference a research funding proposal**.

ALL Sections of the Human Subjects Instructions must be completed with the exception of the Section entitled "Special Consent Provisions." Complete that Section if applicable. When other Sections are not applicable, list the Section Heading and indicate "N/A."

NOTE: The Research Plan is required with ALL submissions and MUST follow the template, and include version number or date, and page numbers.

DO NOT DELETE SECTION HEADINGS OR THE INSTRUCTIONS.

I. TITLE

MOTHER-INFANT SYNCHRONY DURING INFANT FEEDING

II. STAFFING

A. In the table below (add additional rows as needed), indicate: (1) key project personnel including the principal investigator and individuals from other institutions, (2) their qualifications, and (3) a brief description of their responsibilities.

NAME OF INDIVIDUAL	QUALIFICATIONS	RESPONSIBILITIES
Rita H. Pickler	PhD, RN, PNP	Principal investigator, Faculty Advisor, School of Nursing
Barbara A. Reyna	MS, RN, NNP, PhD Candidate	Student Investigator
Lisa Brown	PhD, RN	Dissertation Committee Member, School of Nursing

B. Describe the process that you will use to ensure that all persons assisting with the research are adequately informed about the protocol and their research-related duties and functions.

The principal investigator and student will meet monthly to evaluate study progress.
The student investigator will train Dr. Brown, whose data are being used, in the study tool for interrater reliability.

III. CONFLICT OF INTEREST

Describe how the principal investigator and sub/co-investigators might benefit from the subject's participation in this project or completion of the project in general. Do not describe (1) academic recognition such as publications or (2) grant or contract based support of VCU salary commensurate with the professional effort required for the conduct of the project

The principal investigator and student investigator will derive no personal or financial benefits from the conduct of this study. This is a student study being undertaken in partial fulfillment of the requirements for the degree of Doctor of Philosophy (Nursing).

IV. RESOURCES

Briefly describe the resources committed to this project including: (1) time available to conduct and complete the research, (2) facilities where you will conduct the research, (3 availability of medical or psychological resources that participants might require as a consequence of the research (if applicable), and (4) financial support.

The student investigator will devote a minimum of 20 hours per week to the study. The study involves the coding existing data housed in an electronic database developed from original videotapes. This database, which was acquired from videotapes made during of Dr. Lisa Brown's IRB approved dissertation study at the University of Wisconsin, will be accessed in a secure and private research office in the School of Nursing that has been designated to the PI for use in her research. Additional data from Dr. Brown's study includes questionnaire and demographic data. All data have been de-identified and are in an excel file. There is no direct contact with participants who completed their participation in the project over 5 years ago. There is no financial support for this project.

V. HYPOTHESIS

Briefly state the problem, background, importance of the research, and goals of the proposed project.

The early attachment behavior between a mother and her infant has been well described in both the nursing and psychology literature. A "dance" between a mother and her infant occurs that can be affected by a number of factors, particularly if the infant is born prematurely (Schmucker et al, 2005). Mothers of preterm infants interact differently with their infants and these infants respond differently than infants born at term gestation (Holditch-Davis, Miles, & Belyea, 2000; Schmucker et al., 2005). The degree of sensitivity and attunement of a mother to her infant is important to the developing relationship (Pridham, Schroeder, Brown, & Clark, 2001). However, multiple maternal factors such as depression, stress and anxiety, low self-esteem and perceived support can affect maternal responsiveness (Amankwaa, Pickler, & Boonmee, 2007). In addition, the infant's neurobiological risk and the separation imposed by the NICU environment can affect the attachment process (Schmucker et al., 2005, Oehler, Hannan, & Catlett, 1993).

Synchrony between a mother and her infant is fundamental to the attachment relationship and encompasses multiple constructs that characterize the mother-infant relationship as being mutually responsive. Mother-infant synchrony is a dyadic interaction that provides for an observable pattern that is mutually regulated, harmonious and reciprocal (Harrist & Waugh, 2002). Feeding is an essential activity that provides an opportunity for interaction between a mother and her infant. Post discharge, preterm infant oral feeding skills continue to mature as well as the ability to handle the physiologic stress of feeding. During the post-discharge period, mothers are also learning to recognize and interpret their infants' cues and adapt to their infants' changing abilities (Reyna, Pickler & Thompson, 2006). Thus, the period following discharge represents a time of transition for the mother and preterm infant relationship and the development of synchrony.

Mother-infant synchrony, however, has been difficult to measure. Thus, researchers who have developed and are testing interventions aimed at strengthening mother-infant attachment are limited in their ability to measure the effect of those interventions.

The purpose of the proposed study is to develop an observational measure of early mother-infant synchrony using a regularly occurring, necessary caregiving activity, feeding, as the context.

References

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VI. SPECIFIC AIMS

The primary aim of this descriptive, longitudinal study is to further develop and test a coding system for assessing synchrony of feeding interaction between a mother and her preterm infant.
The secondary aims are to:

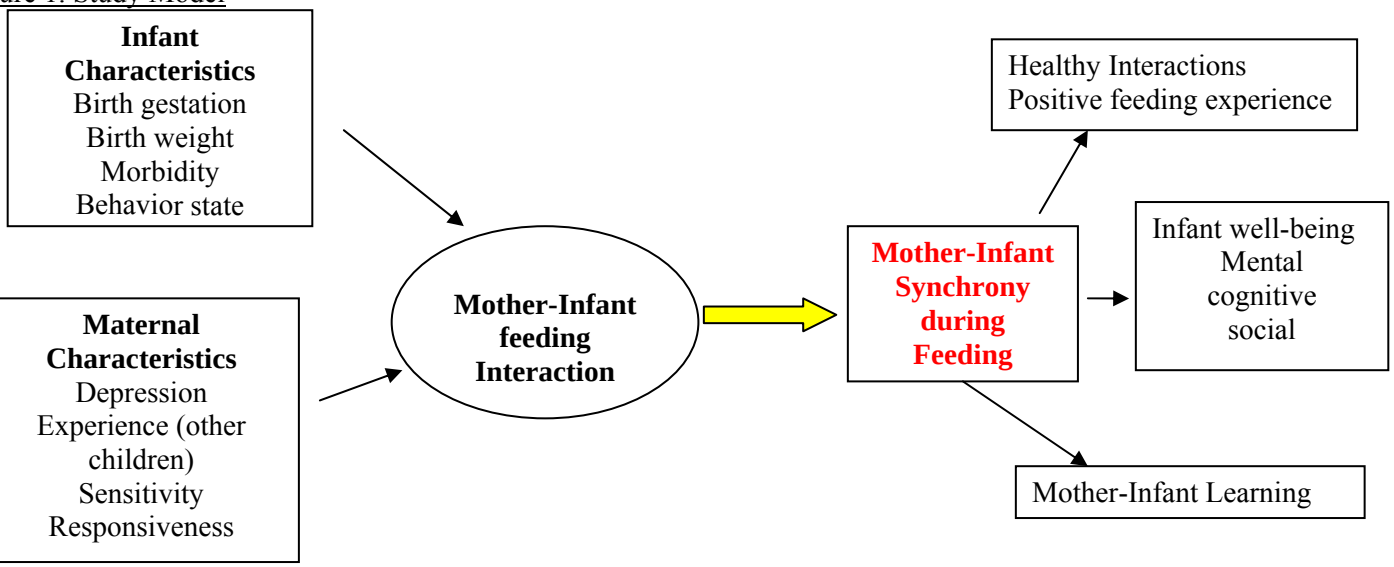
1. Describe mother and preterm infant synchrony during feeding.
2. Examine mother-infant synchrony during feeding over time.
3. Examine the mediating effects of infant severity of illness, behavior state, birth gestation and birth weight and maternal depression and maternal responsiveness and sensitivity on mother-infant synchrony.
4. Test the criterion-related validity of the synchrony scale with the Dyadic Tension (DT) Scale and the Dyadic Mutality and Reciprocity (DMR) Scale of the Parent-Child Early Relational Assessment (PCERA).

VII. BACKGROUND AND SIGNIFICANCE

Include information regarding pre-clinical and early human studies. Attach appropriate citations.

In describing synchrony, the emphasis is on the mother-infant dyad as an interactive system. How this system functions is influenced by the unique characteristics of the mother and infant and how each modifies his or her behavior in response to the other. A positive synchronous interaction is characterized as adaptive, reciprocal, and flexible. Moreover, there is rhythmicity to the interaction as each member makes behavioral adjustments in order to maintain balance in the system (Barnard, 1987). Other variables that may be indirect measures of dyadic function are maternal factors such as stress, self-esteem, depression and perceived support (Amankwaa, Pickler, & Boonmee, 2007; Cornish, et al., 2006). Infant factors such as prematurity and the effects of the intensive care environment can impact the infant's behavior and influence the dynamics of the mother-infant dyad (Whitfield, 2003). It has been shown that depressed mothers have a less positive affect and demonstrate less matching of positive behaviors with their infants (Feldman, 2007). In addition, mothers who are less emotionally available and less affectively responsive may result in less synchronous interactions. The combined effect of maternal and preterm infant characteristics such as severity of illness, infant irritability and maternal stress, education and race can influence the quality of the mother-infant interaction (Holditch-Davis, Schwartz, Black, & Scher, 2007).
The model of the proposed study is shown in Figure 1. The infant characteristics of birth gestation, birth weight, severity of illness and behavior state at the time of feeding and the maternal effects of depression, experience (other living children) and degree of responsiveness and sensitivity during the feeding interaction will be measured for their mediating effects on the development of synchrony. Outcomes of synchrony using the MISS will be addressed in future studies.

Figure 1. Study Model



Significance: There is growing evidence that adverse events around birth can influence brain development and affect outcomes. The mother has a crucial role in providing the foundations for developing an infant's self-regulatory skills. Through repeated interactions the infant learns what to expect in exchanges with others. In addition, when an infant responds as expected the mother learns what she does is important. This exchange promotes a healthy relationship between a mother and infant and fosters a positive sense of self for the infant. Understanding how these early experiences influences later development may influence care provision for high-risk populations, such as infants born preterm. Difficulties with attention regulation do not become apparent until school-age in many of these children. Thus little attention has been paid to assisting mothers in their efforts to interact in synchronous, developmentally supportive ways with their infants. Identifying the occurrence of synchronous interactions between a mother and infant and factors influencing this relationship will be important in developing interventions to promote affective and cognitive development. The results of this study will provide a tool for measuring mother-infant synchrony from which interventions can be developed and tested that facilitate the emerging mother-infant relationship.

References

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VIII. PRELIMINARY PROGRESS/DATA REPORT

If available.

In the Fall of 2007, the student investigator, under the direction of Dr. Brown and Dr. Pickler, completed a research practicum using Dr. Brown's database developed during her dissertation. The purpose of this practicum was to explore the feasibility of using categories of behavior from the Mother Infant Feeding Tool (MIFT), developed during Dr. Brown's study, to identify the range of mother and preterm infant behaviors during feeding (Brown, Thoyre, Pridham & Schubert,

In Press). In the practicum, behaviors were coded as being positive or negative based on their theoretical impact on synchrony or feeding outcomes. This resulted in the development of a preliminary tool for measuring synchrony, the Mother-Infant Synchrony Scale (MISS). However, further refinement of the MISS is needed as some behaviors observed *in the database* could be considered positive, negative or neutral depending on the context in which the behavior occurred or the response the behavior elicited from the infant.

References

Brown, L.F, Thoyre, S., Pridham, K., & Schubert, C. (In Press). The mother-infant feeding tool. *Journal of Obstetric, Gynecologic, and Neonatal Nursing.*

IX. RESEARCH METHOD AND DESIGN

Include a brief description of the project design including the setting in which the research will be conducted and procedures. If applicable, include a description of procedures being performed already for diagnostic or treatment purposes.

A secondary analysis of existing, de-identified data is planned for the proposed study. As part of a larger study examining maternal feeding competence conducted by Dr. Lisa Brown as part of her dissertation study (Correlates of an Adaptive Mother-Infant Relationship, 2004, University of Wisconsin), 43 mothers were videotaped while feeding their preterm infants at three intervals – just before discharge in the nursery and then in their home at 1 month and 4 months post menstrual age (PMA). Study participants were recruited from three nurseries in Wisconsin. A staff nurse approached mothers at two of the hospitals about the study and in the third, a flyer describing the study was left for the mother. Once the mother indicated an interest in learning more about the study, the investigator (Dr. Brown) contacted the mother in person and further described the study. The mother was then given an opportunity to think over the information and was contacted by the study investigator 24-48 hours later to obtain informed consent. Participating mothers were assigned an ID number that was used for the video and demographic forms. All data were de-identified. *The videotapes collected during Dr. Brown's study have been loaded into an electronic database system (Noldus, described below in Section XI); the original videotapes are not available to the student investigator. There is currently no way to link names to any of the images in the database.*

For the proposed study, two phases are planned.

Phase 1 will be a pilot study using a convenience sample of 3 mother-infant dyads (*9 data subsets*) to test the revised MISS that was developed during the student's research practicum as described above. *The MISS is a recoding from existing data obtained, as originally consented to by participants, to "learn more about the well-being of infants who are born preterm and the well-being of their mothers over time" (see attached original consent forms from UW).* The MISS is a result of further refinement the categories and code descriptors of mother and infant behaviors that were identified by Dr. Brown in her dissertation study. The refinement was undertaken in order to more accurately describe the dyadic nature of the relationship. Five categories comprise the mother behaviors; attention, affect, feeding, tactile and vestibular. Infant behavior categories are; attention, affect, feeding and tone. A third category is mutuality and involves the mother and infant behaving simultaneously. In addition, most early interactions of mothers with their preterm infants contain some dyssynchrony because they are learning how to interact (Biringen, Emde, & Pipp-Siegel, 1997). Therefore, additional items in this category will address any maternal attempts at adjustment; referred to as repair in the literature. This would include mother's attempt to engage her infant or adjust for a negative infant behavior. Any changes in this repair process over time will also be noted. The 9 *data subsets* will be coded using the MISS by the student investigator. For interrater reliability, a random selection of these will also be coded by Dr. Brown using the MISS.

Phase 2 will address the primary and secondary aims of the study. This phase will use a convenience sample from the larger study of 10 mother-infant dyads (*30 data subsets*).

To address the primary aim of the study and develop and test a coding system for assessing synchrony of feeding interaction between a mother and her preterm infant, 30 *data subsets* will be coded using the revised MISS.

The study's secondary aims will use the behaviors coded from the revised MISS and the de-identified demographic data obtained during Dr. Brown's study.

2.1 & 2.2. From the MISS, the frequency and duration of occurrence of mother and infant behaviors during feeding will be examined and the relationship of these behaviors as well as their co-occurrence with other behaviors will be described and examined for changes over time. MISS scores will also be examined for change over time.

2.3. To examine the mediating effects of infant and maternal characteristics, available infant and maternal data will be used. A severity of illness score will be calculated using the Neonatal Medical Index (NMI). Behavior state using the Anderson Behavior State Scale (ABSS) will be scored on the infant from the first minute of feeding as recorded on each video. Gestational age and birth weight are readily available in the de-identified database. Available maternal data include maternal depression as scored on the Center for Epidemiologic Study-Depression (CES-D) Scale and experience (other living children) and maternal responsiveness and sensitivity scored from the Positive Affective Involvement and Sensitivity/Responsiveness (PAISR) scale of the Parent-Child Early Relational Assessment (PCERA).

2.4. The mother-infant dyads have also been scored for dyadic tension and reciprocity using the Dyadic Tension (DT) Scale and the Dyadic Mutality and Reciprocity (DMR) Scale. These scores will be used to test the criterion-related validity of the MISS.

The following is a description of the measures that will be used to meet the aims of the study.

The Mother-Infant Synchrony Scale (MISS) is an observational assessment tool with 3 categories: mother behaviors, infant behaviors and mutuality. Each category contains subcategories of behaviors. The maternal subcategories are; attention, affect, feeding, tactile and vestibular. The infant behavior subcategories are; attention, affect, feeding and tone. Mutuality addresses mother and infant behaviors that occur simultaneous. The behaviors within each category are mutually exclusive. ***The MISS will be applied as described above to existing data subsets in the Noldus database.***

The Parent-Child Early Relational Assessment (PCERA) is a 65-item observational rating scale using 5-point Likert scales. It was designed to assess the amount, duration and intensity of adaptive parent and infant behavior. The PCERA contains six subscales. For this study, three of the subscales will be used. The Dyadic Tension (DT) scale and the Dyadic Mutality and Reciprocity (DMR) scale examine the contribution of each member of the dyad to the interaction. Each item is rated on the quality, intensity, or amount or duration of behavior. Item score of 1 and 2 are considered areas of concern, 3 is an area of some concern, and 4 and 5 are areas of strength. The Positive Affective Involvement and Sensitivity/Responsiveness (PAISR) Scale examines adaptive maternal feeding behavior. It is a 17 item subscale that contains variables measuring a mother's sensitivity and responsiveness to her infant's cues. It includes how the mother structures and modifies the environment, genuine visual regard and mirroring of the infant's feelings. ***The PCERA has already been administered as part of the original data analysis and the scale scores are part of the existing data base.***

The Neonatal Medical Index (NMI) will be used to assess the biologic condition (severity of illness) of the infants. The NMI classifies preterm infants by summarizing their medical conditions. Classifications range from 1 for infants born weighing more than 1000 g and without major complications, to a score of 5 for infants born weighing less than 1000 g and with very serious complications. The NMI can be scored from existing de-identified *numeric* data.

To assess for maternal symptoms of depression, the Center for Epidemiologic Study-Depression (CES-D) Scale will be used to measure level of depressive symptoms. It is a 20-item scale assessing for depressive mood, feelings of guilt and worthlessness, feelings of helplessness and hopelessness, loss of energy, and appetite and sleep disturbances. Participants rate the frequency of symptoms over the past week ranging from "rarely or none of the time" to "most or all of the time". A total score is obtained by summing the score for each item, with a total score range of 0 to 60. Higher scores indicate more depressive symptoms. Participants in Dr. Brown's study completed the CES-D and their responses are included in the de-identified *numeric* database.

The Anderson Behavioral State Scale (ABSS) describes 12 sleep and awake states in infants. There are four measures of sleep, five measures of awake, and three levels of crying. Scoring involves observing the infant for a 60-second interval and then scoring the highest state that occurs. The ABSS will be scored by the student investigator by watching the first 60 seconds of *each data subset in the Noldus database* and scoring for the highest state that occurred.

References
Biringen, Z., Emde, R.N., & Pipp-Siegel, S. (1997). Dyssynchrony, conflict, and resolution: Positive contributions to infant development. *American Journal of Orthopsychiatry, 6*, 4-19.

X. PLAN FOR CONTROL OF INVESTIGATIONAL DRUGS (If the VCUHS Investigational Drug Pharmacy is not used), DEVICES, AND BIOLOGICS

Describe your plans for the control of investigational products including: (1) how you will maintain records of the product's delivery to the trial site, the inventory at the site, the use by each subject, and the return to the sponsor or alternative disposition of unused product(s); (2) plan for storing the investigational product(s) as specified by the sponsor (if any) and in accordance with applicable regulatory requirements; (3) plan for ensuring that the investigational product(s) are used only in accordance with the approved protocol; and (4) how you will ensure that each subject understands the correct use of the investigational product(s) (if applicable) and check that each subject is following the instructions properly (on an ongoing basis).

NA

XI. DATA ANALYSIS PLAN

For investigator–initiated studies.

The *data subsets* will be *recoded* for the maternal and infant behaviors using the Mother-Infant Synchrony Scale (MISS). The Noldus Observer XT software package will be used to facilitate *data* review and behavioral coding. The Observer software allows the researcher to examine the *data* and *recode* for predetermined events. The researcher can view the data and mark behaviors as either state events which are measured in seconds, or point events, which do not have duration. The data will be analyzed for the frequency and duration of occurrence as well as their co-occurrence with other behaviors.

Primary aim: Each *data subset* will be scored using the MISS. The coding will occur continuously and in real time throughout the feeding. Mother and infant behaviors will be coded in separate reviews. Each data subset will be reviewed a minimum of 6 times (3 passes for mother observation and 3 passes for infant). To determine inter-rater reliability, a blinded coder, trained to 80% reliability coding the MISS, will code a random sample of 10% of the data. A Kappa coefficient will be computed to demonstrate reliability.

Secondary aims:
2.1 Descriptive statistics will be used to describe the occurrence of infant and mother behaviors. The percentage of occurrence of each behavior and the percentage of time the behavior occurred within each feeding will be calculated for each data subset and then summarized for each measurement point (discharge, 1 and 4 months PMA). In addition, using the capabilities of the Noldus system, a grid/graph/table will be created showing the temporal relationships among maternal and infant behaviors. These temporal relationships will be described.

2.2 The MISS score determined in Aim 1 will be examined for changes over time. Repeated measures ANOVA will be used for this analysis.

2.3 The mediation effects of the infant (behavior state, morbidity, birth gestation and birth weight) and maternal (depressive symptoms, experience, responsiveness and sensitivity) characteristics, will be tested using regression analysis. Infant and maternal characteristics will be regressed on the MISS score.

2.4 To test the criterion validity of the MISS, scores on the MISS will be compared to the DT and DMR scores using correlation coefficients. The correlations of scores across the three measurement periods will also be examined.

XII. DATA AND SAFETY MONITORING

- **If the research involves greater than minimal risk and there is no provision made for data and safety monitoring by any sponsor, include a data and safety-monitoring plan that is suitable for the level of risk to be faced by subjects and the nature of the research involved.**
- **If the research involves greater than minimal risk, and there is a provision made for data and safety monitoring by any sponsor, describe the sponsor's plan.**

- **If you are serving as a Sponsor-Investigator, identify the Contract Research Organization (CRO) that you will be using and describe the provisions made for data and safety monitoring by the CRO. Guidance on additional requirements for Sponsor-Investigators is available at http://www.research.vcu.edu/irb/wpp/flash/wpp_guide.htm#X-2.htm**

The proposed study involves no contact with the subjects. The *existing Noldus housed database* of mothers feeding their preterm infants were part of a descriptive study and involved no intervention.

XIII. MULTI-CENTER STUDIES

If VCU is the lead site in a multi-center project or the VCU PI is the lead investigator in a multi-center project, describe the plan for management of information that may be relevant to the protection of subjects, such as reporting of unexpected problems, project modifications, and interim results.

NA

XIV. INVOLVEMENT OF NON-VCU INSTITUTIONS/SITES (DOMESTIC AND FOREIGN)

1. Provide the following information for each non-VCU institution/site (domestic and foreign) that has agreed to participate:

- **Name of institution/site**
- **Contact information for institution/site**

NA

2. For each institution, indicate whether or not it is "engaged" in the research (see OHRP's guidance on "Engagement of Institutions in Research" at http://www.hhs.gov/ohrp/humansubjects/assurance/engage.htm.)

NA

3. Provide a description of each institution's role (whether engaged or not) in the human subjects research, adequacy of the facility (in order to ensure human subject safety in the case of an unanticipated emergency), responsibilities of its agents/employees, and oversight that you will be providing in order to ensure adequate and ongoing protection of the human subjects. You should only identify institutions that have agreed to participate. If additional institutions agree to participate at a later time, they must be added by amendment to the protocol.

NA

4. For each institution that is "engaged" provide an OHRP Federalwide Assurance (FWA) # if: (1) the research is not exempt, AND (2) the research involves a DIRECT FEDERAL award made to VCU (or application for such).

NOTE: Additional guidance at http://www.research.vcu.edu/irb/wpp/flash/wpp_guide.htm#XVII-6.htm, and http://www.research.vcu.edu/irb/wpp/flash/wpp_guide.htm#XVII-11.htm.

NA

XV. INVOLVEMENT OF INDEPENDENT INVESTIGATORS

INDEPENDENT INVESTIGATOR: an individual who is acting independently and not acting as an agent or employee of any institution or facility while carrying out his or her duties in the research protocol. Additional guidance at http://www.research.vcu.edu/irb/wpp/flash/wpp_guide.htm#XVII-15.htm.

ENGAGEMENT IN RESEARCH: An independent investigator becomes "engaged" in human subjects research when he/she (i) intervenes or interacts with living individuals for research purposes; or (ii) obtains individually identifiable

private information for research purposes [45 CFR 46.102(d)-(f)]. See OHRP's guidance on "Engagement of Institutions in Research" at http://www.hhs.gov/ohrp/humansubjects/assurance/engage.htm.

1. Provide a list of independent investigators.

2. For each independent investigator indicate whether or not he/she is "engaged" or "not engaged" in the research

3. For each independent investigator who is "engaged": (1) describe his/her role with human subjects/identifiable human data, AND (2) describe YOUR oversight of his/her involvement.

NA

NOTE: If an independent investigator is "engaged," and the research is (1) not exempt AND (2) involves a DIRECT FEDERAL award made to VCU (or application for such), the independent investigator must sign a formal written agreement with VCU certifying terms for the protection of human subjects. For an agreement to be approved: (1) the PI must directly supervise all of the research activities, (2) agreement must follow the ORSP template, (3) IRB must agree to the involvement of the independent investigator, AND (4) agreement must be in effect prior to final IRB approval.

XVI. HUMAN SUBJECTS INSTRUCTIONS (Be sure to use the sub-headings under A-I)

ALL sections of the Human Subjects Instructions must be completed with the exception of the section entitled "Special Consent Provisions." Complete that section if applicable.

A. DESCRIPTION

Provide a detailed description of the proposed involvement of human subjects or their private identifiable data in the work.

There is no direct human subject involvement. All data has been de-identified. The data were collected during the course of a University of Wisconsin IRB approved study.

B. SUBJECT POPULATION

Describe the subject population in terms of sex, race, ethnicity, age, etc., and your access to the population that will allow recruitment of the necessary number of participants. Identify the criteria for inclusion or exclusion of any subpopulation and include a justification for any exclusion. Explain the rationale for the involvement of special cases of subjects, such as children, pregnant women, human fetuses, neonates, prisoners or others who are likely to be vulnerable. If you plan to allow for the enrollment of Wards of the State (or any other agency, institution, or entity), you must specifically request their inclusion and follow guidance on Wards and Emancipated Minors in the VCU IRB Written Policies and Procedures (specifically WPP#: XV-3) available at http://www.research.vcu.edu/irb/wpp/flash/wpp_guide.htm#XV-3.htm.

The de-identified data being used in this secondary analysis were collected and stored in numeric (Excel-based) and visual (Noldus-based) databases. The original videotapes are not available to the student investigator. There is no link between either of the databases and any identifying information. As part of a larger study examining maternal feeding competence, 43 mother-infant dyads were recruited from three special care nurseries in the Midwest. Thirty-one (72%) of the mothers recruited were white, six (14%) were black, one (2%) was Asian, two (5%) were Latino, one (2%) was middle Eastern, and two (5%) were biracial. Twenty-nine (67%) of the mothers were married, five (12%) had a partner but they did not live together, four (9%) had a partner they lived with, and 1 (2%) was divorced or separated. The sample eligibility included maternal age ≥17 years and the ability to speak and read English. Inclusion criteria for the infants were ≤ 35 weeks at birth, appropriate weight for gestation age, no major congenital malformations and no known drug exposure. Both breast and bottle fed infants were included. Infants with a Grade II intraventricular bleed or greater were not included. For the proposed study a convenience sample of 10 mother-infant dyads who completed all three data collection points (30 data subsets) will be used to test the synchrony tool.

C. RESEARCH MATERIAL

Identify the sources of research material obtained from individually identifiable living human subjects in the form of

specimens, records, or data. Indicate whether the material or data will be obtained specifically for research purposes or whether use will be made of existing specimens, records, or data.

Research material includes only existing and de-identified data which is in the form of an Excel spreadsheet or a Noldus database.

D. RECRUITMENT PLAN

Describe <u>in detail</u> your plans for the recruitment of subjects including: (1) how potential subjects will be identified (e.g., school personnel, health care professionals, etc), (2) how you will get the names and contact information for potential subjects, and (3) who will make initial contact with these individuals (if relevant) and how that contact will be done. If you plan to involve special cases of subjects, such as children, pregnant women, human fetuses, neonates, prisoners or others who are likely to be vulnerable, describe any special recruitment procedures for these populations.

There is no plan to recruit additional subjects; o*nly existing data will be used.*

E. POTENTIAL RISKS

Describe potential risks whether physical, psychological, social, legal, or other and assess their likelihood and seriousness. Where appropriate, describe alternative treatments and procedures that might be advantageous to the subjects.

There are no potential risks to the subjects. All data have been de-identified.

F. RISK REDUCTION

Describe the procedures for protecting against or minimizing potential risk. Where appropriate, discuss provisions for ensuring necessary medical or professional intervention in the event of adverse events to the subjects. Also, where appropriate, describe the provisions for monitoring the data collected to ensure the safety of subjects.

Data are maintained on a secure server. Analysis of the data occurs in the School of Nursing in a secure setting.

G. ADDITIONAL SAFEGUARDS IF ANY PARTICIPANTS WILL BE VULNERABLE

Describe any additional safeguards to protect the rights and welfare of participants if you plan to involve special cases of subjects, such as children, pregnant women, human fetuses, neonates, prisoners or others who are likely to be vulnerable. Safeguards to protect the rights and welfare of participants might relate to Inclusion/Exclusion Criteria: ("Adults with moderate to severe cognitive impairment will be excluded." "Children must have diabetes. No normal controls who are children will be used.") Consent: ("Participants must have an adult care giver who agrees to the participant taking part in the research and will make sure the participant complies with research procedures." "Adults must be able to assent. Any dissent by the participant will end the research procedures.") Benefit: ("Individuals who have not shown benefit to this type of drug in the past will be excluded.").

All of the data has been de-identified. There is no risk as there is no direct contact with participants.

H. CONFIDENTIALITY

Describe how the confidentiality of data collected as part of this project will be protected including pre-screening data (e.g., physical controls on the data; access controls to the data; coding of data; legal controls, such as a Federal Certificate of Confidentiality; statistical methods; or reporting methods).

All of the data have been de-identified.

I. PRIVACY

Describe how the privacy interests of subjects will be protected where privacy refers to persons and their interests in controlling access to themselves, and assess their likely effectiveness. Identify what steps you will take for subjects to

be comfortable: (1) in the research setting and (2) with the information being sought and the way it is sought.

Only existing data will be used. There is no contact with the subjects.

J. RISK/BENEFIT

Discuss why the risks to subjects are reasonable in relation to the anticipated benefits to subjects and in relation to the importance of the knowledge that may reasonably be expected to result. If a test article (investigational new drug, device, or biologic) is involved, name the test article and supply the FDA approval letter.

There are no real or potential benefits to participants. There are no risks to participants.

K. COMPENSATION PLAN

Compensation for subjects (if applicable) should be described, including possible total compensation, any proposed bonus, and any proposed reductions or penalties for not completing the project.

In the larger study, subjects received a monetary stipend for their participation. As this study involves the use of the data only, there is no further compensation.

L. CONSENT ISSUES

1. CONSENT PROCESS

Indicate who will be asked to provide consent/assent, who will obtain consent/assent, what language (e.g., English, Spanish) will be used by those obtaining consent/assent, where and when will consent/assent be obtained, what steps will be taken to minimize the possibility of coercion or undue influence, and how much time will subjects be afforded to make a decision to participate.

Informed consent was obtained from all study participants. The study consent form was approved through the Clinical Science Center Human Subjects Committee at the University of Wisconsin-Madison and the human subjects committee at the participating hospitals. *Informed consent was obtained over 5 years ago. The study PI (Dr. Brown) continues to analyze the existing data, which are housed in Excel or Noldus databases. The current study involves a reanalysis of the existing data using a modification of a previously used coding system. The aim of this proposed analysis continues the purpose of the study to examine the effects of the caregiving environment, baby's behavior and development on the early relationship with the mother. Reconsenting participants would involve re-identifying the subjects (and thus the data would no longer be de-identified) and require linking the first names of the participants, which were initially used to contact participants for follow-up appointments, to the consent forms in order to obtain the full names and addresses.*

2. SPECIAL CONSENT PROVISIONS

If some or all subjects will be cognitively impaired, or have language/hearing difficulties, describe how capacity for consent will be determined. Please consider using the VCU Informed Consent Evaluation Instrument available at http://www.research.vcu.edu/irb/guidance.htm. If you anticipate the need to obtain informed consent from legally authorized representatives (LARs), please describe how you will identify an appropriate representative and ensure that their consent is obtained. Guidance on LAR is available at http://www.research.vcu.edu/irb/wpp/flash/wpp_guide.htm#XI-3.htm.

NA

3. If request is being made to WAIVE SOME OR ALL ELEMENTS OF INFORMED CONSENT FROM SUBJECTS OR PERMISSION FROM PARENTS, explain why: (1) the research involves no more than minimal risk to the subjects, (2) the waiver or alteration will not adversely affect the rights and welfare of the subjects, (3) the research could not practicably be carried out without the waiver or alteration; AND (4) whether or not subjects will be debriefed after their participation. Guidance is available at http://www.research.vcu.edu/irb/wpp/flash/wpp_guide.htm#XI-1.htm.. NOTE: Waiver is not allowed for FDA-regulated research unless it meets FDA requirements for Waiver of Consent for Emergency Research (see below).

*A request for waiver of **additional** consent.*
*Waiver of **additional** consent:*

1. *This reanalysis of existing data involves minimal risk. The data were collected under minimal risk policies, the data involve everyday activities (mothers feeding their babies), and there is no identifying information in the data.*
2. *Waiver of **additional** consent will not affect the participants' rights since they agreed to the purposes of the study, which this reanalysis continues. In fact, reconsenting participants would involve re-identifying them (and thus the data would no longer be de-identified) and require linking the first names of the participants, which were initially used to contact participants for follow-up appointments, to the consent forms in order to obtain the full names and addresses.*
3. *This reanalysis of existing data could not be practicably carried out if **additional** consent is required. Contact information for the participants exists only in the form of first names and addresses. There are no last names in the contact information files. Thus, to retrieve last names requires obtaining all the consent forms, matching the consent forms to subject identification names (currently random codes) and then linking them in order to develop a new contact list. This would in essence, re-identify the participants. Moreover, the consent forms may or may not still be available. In addition, our experience from previous studies involving longitudinal data indicates that the likelihood of names and addresses remaining the same over the past 5 years is small (likely less than 10%). Finally, recontacting participants after 5 or more years to request permission for the further analysis of data that they have already consented to be used for research and that have been deidentified seems to place families at risk of invasion of privacy.*
4. *Subject debriefing is not pertinent to this study; subjects gave written consent for the study purposes, which are continuing in this existing data reanalysis.*

4. If request is being made to WAIVE DOCUMENTATION OF CONSENT, provide a justification for waiver based on one of the following two elements AND include a description of the information that will be provided to participants: (1) the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. Subject will be asked whether they want documentation linking them with the research, and each subject's wishes will govern; or (2) the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context. Guidance is available at http://www.research.vcu.edu/irb/wpp/flash/wpp_guide.htm#XI-2.htm

NA

5. If applicable, explain the ASSENT PROCESS for children or decisionally impaired subjects. Describe the procedures, if any, for re-consenting children upon attainment of adulthood. Describe procedures, if any, for consenting subjects who are no longer decisionally impaired. Guidance is available at http://www.research.vcu.edu/irb/wpp/flash/wpp_guide.htm#XV-2.htm.and http://www.research.vcu.edu/irb/wpp/flash/wpp_guide.htm#XVII-7.htm.

NA

6. If request is being made to WAIVE THE REQUIREMENT TO OBTAIN ASSENT from children age 7 or higher, or decisionally impaired subjects, explain why: (1) why some or all of the individuals age 7 or higher will not be capable of providing assent based on their developmental status or impact of illness; (2) the research holds out a prospect of direct benefit not available outside of the research; AND/OR (3) [a] the research involves no more than minimal risk to the subjects, [b] the waiver or alteration will not adversely affect the rights and welfare of the subjects, [c] the research could not practicably be carried out without the waiver or alteration; AND [d] whether or not subjects will be debriefed after their participation. Guidance is available at http://www.research.vcu.edu/irb/wpp/flash/wpp_guide.htm#XV-2.htm

NA

7. If request is being made to waive consent for emergency research, see guidance at http://www.research.vcu.edu/irb/wpp/flash/wpp_guide.htm#XVII-16.htm.

NA

8. If applicable, address the following issues related to GENETIC TESTING:

a. FUTURE CONTACT CONCERNING FURTHER GENETIC TESTING RESEARCH
Describe the circumstances under which the subject might be contacted in the future concerning further participation in this or related genetic testing research.

NA

b. FUTURE CONTACT CONCERNING GENETIC TESTING RESULTS
If planned or possible future genetic testing results are unlikely to have clinical implications, then a statement that the results will not be made available to subjects may be appropriate. If results might be of clinical significance, then describe the circumstances and procedures by which subjects would receive results. Describe how subjects might access genetic counseling for assistance in understanding the implications of genetic testing results, and whether this might involve costs to subjects. Investigators should be aware that federal regulations, in general, require that testing results used in clinical management must have been obtained in a CLIA-certified laboratory.

NA

c. WITHDRAWAL OF GENETIC TESTING CONSENT
Describe whether and how subjects might, in the future, request to have test results and/or samples withdrawn in order to prevent further analysis, reporting, and/or testing.

NA

d. GENETIC TESTING INVOLVING CHILDREN OR DECISIONALLY IMPAIRED SUBJECTS
Describe procedures, if any, for consenting children upon the attainment of adulthood. Describe procedures, if any, for consenting subjects who are no longer decisionally impaired.

NA

e. CONFIDENTIALITY
Describe the extent to which genetic testing results will remain confidential and special precautions, if any, to protect confidentiality.

NA

CHAPTER 3

Mother-Infant Synchrony during Infant Feeding

The following manuscript was prepared to describe the findings on this study. The format used is consistent with requirements for a manuscript-format dissertation. The manuscript is prepared in the style of a select journal that publishes research about infant development.

Mother-Infant Synchrony during Infant Feeding

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Abstract

Purpose: The purpose this study was to develop and test a coding system, the Maternal-Infant Synchrony Scale (MISS) for assessing synchrony of feeding interaction between a mother and her preterm infant. The secondary aims were to: (1) describe mother and preterm infant synchrony during feeding; (2) examine mother-infant synchrony during feeding over time; (3) examine the mediating effects of infant severity of illness, behavior state, birth gestation and birth weight and maternal depression, and maternal responsiveness and sensitivity on mother-infant synchrony; and (4) test the criterion-related validity of the synchrony scale.

Methods: A descriptive, longitudinal design using data collected during an early study was employed; a sample dataset from 10 mother-infant dyads that completed three data collection points were used. Data were also collected on maternal depression and responsiveness and sensitivity and dyadic tension and reciprocity. Scores for infant severity illness and behavior state were computed. The Noldus Observer XT 8.0 (Noldus Information Technology b.v., 2006) was used for data review and coding. The MISS was created by determining the frequency of select behaviors and the percentage of time behaviors occurred during the feeding; changes in behaviors over the three observations periods were calculated.

Results: Mothers were attentive and focused during feedings. The influence of infant maturation on feeding behaviors was evident across observations; infant attempts at interaction were greater than the mother attempts to engage her infant. MISS scores were not significantly different over the observations, the selected mediators had no significant effect on synchrony and the criterion validity for the MISS was not established.

Conclusion: This study revealed behaviors that are descriptive of the interaction and can be used to develop interventions that would support the developing relationship. Use of the MISS with a larger sample size and a cohort of healthy, term newborns is needed to establish the MISS as a valid and reliable measure of synchrony.

Key words: mother-infant synchrony, mother-infant interaction, synchrony tool, preterm infant feeding

Mother-Infant Synchrony during Infant Feeding

1. Introduction

Synchrony between a mother and her infant describes a dyadic characteristic that is essential to the developing relationship (Bowlby, 1982). A synchronous mother-infant interaction is characterized by being mutually responsive with an observable pattern of reciprocity and harmony between the dyad (Harrist & Waugh, 2002; Isabella, Belsky & von Eye, 1989). Inherent to this interaction is a rhythmic attention-withdrawal pattern that occurs as the mother regulates her level of attention in response to changes in her infant's responsiveness (Brazelton, Koslowksi & Main, 1974). Thus, the occurrence of synchronous patterns during an interaction provides the infant with a template for what to expect from future interactions (Sroufe & Fleeson, 1986). Understanding the dynamics of mother-infant interaction and identifying synchronous patterns are therefore important for promoting a healthy relationship.

The importance of the early interactions between a mother and her infant has been well established in the literature. The exchange of behaviors that occur between a mother and her infant has been described as a "dance" which can be affected by a number of factors, particularly if the infant is born prematurely (Feldman, 2007; Schmucker, Brisch, Kohntop et al., 2005). Mothers of preterm infants interact differently with their infants and these infants respond differently than infants born at term gestation (Holditch-Davis, Miles, & Belyea, 2000; Schmucker et al, 2005). The degree of sensitivity and attunement of a mother to her infant is important to the developing relationship (Pridham, Schroeder, Brown & Clark, 2001). However, mother and infant characteristics such as severity of illness, maternal stress, education, race, self-esteem, depression and perceived support can influence dyadic function and have a collective effect on the dyad (Amankwaa, Pickler, & Boonmee, 2007; Cornish, McMahon, & Ungerer, et

al., 2006; Holditch-Davis, Schwartz, Black, & Scher, 2007). Mothers who are depressed have a less positive affect and demonstrate less matching of positive behaviors with their infants which may result in less synchronous interactions (Feldman, 2007). In addition, the infant's neurobiological risk and the separation imposed by the NICU environment can affect the developing relationship (Schmucker et al, 2005; Oehler, Hannan, & Catlett, 1993).

Feeding is an essential activity that provides an opportunity for interaction between a mother and her infant and therefore, provides a context within which synchrony and thus attachment develop (Holditch-Davis et.al, 2000). However, learning to feed a preterm infant requires the mother to recognize and appropriately respond to her infant's cues (Thoyre, 2001). The feeding experience is dynamic, and is influenced by the infant's ability to remain engaged with the feeding. Conversely, the infant's ability to sustain engagement during feeding is influenced by the infant's maturity and behavioral readiness to feed (Thoyre & Brown, 2004). This period of learning for the mother and her infant begins in the newborn intensive care unit (NICU) and extends into the early discharge period.

Following discharge, preterm infant oral feeding skills continue to mature as well as the infant's ability to handle the physiologic stress of feeding and the interaction. During this time, mothers are learning to recognize and interpret their infants' cues and adapt to their infants' changing abilities (Reyna, Pickler & Thompson, 2006). Moreover, only after discharge from the NICU, do mothers generally assume full responsibility for feeding their infant who was born preterm. Thus, while the period of hospitalization is one of great importance for both mother and infant, the period following discharge represents a time of significant transition for the mother and preterm infant relationship and the development of synchrony.

Identifying mother and infant behaviors as a measure of dyadic synchrony is complex, particularly in the early newborn period (Reyna & Pickler, 2009). The challenge is to develop indices of interaction from observed behaviors that would characterize the interaction and can be applied to other dyads (Brown & Bakeman, 1980). Thus, the purpose of this study was to develop and test a coding system, the Maternal-Infant Synchrony Scale (MISS) for assessing synchrony of feeding interaction between a mother and her preterm infant. The secondary aims were to: (1) describe mother and preterm infant synchrony during feeding; (2) examine mother-infant synchrony during feeding over time; (3) examine the mediating effects of infant severity of illness, behavior state, birth gestation and birth weight and maternal depression, and maternal responsiveness and sensitivity on mother-infant synchrony; and (4) test the criterion-related validity of the synchrony scale.

2. Theoretical Background

The theoretical foundation for mother-infant synchrony is John Bowlby's theory of attachment (Bowlby, 1982). It is proposed that at the most fundamental level there is a biological basis for attachment that determines the emergence and general shape of the behavioral organization (Bowlby, 1982; Holmes, 1995). However, Bowlby also recognized the contribution of the infant to developing mother-infant attachment. Basic infant behaviors such as sucking, crying and smiling prompt the mother to respond to her infant. How the mother responds to these cues shapes the infant's behavior to form an integrated response (Bowlby, 1982). Thus, the infant is an active participant rather than a passive bystander in the interaction and underscores the dyadic nature of the relationship. The pattern of interaction developed during early infancy becomes a part of the infant's memory and leads to the infant's feeling of security (Maunder & Hunter, 2001, Kandel, 1999).

The model of a parent-infant feedback system developed by Brazelton and Als (1979) supports Bowlby's theory that the infant's behaviors influence the dynamics of the interaction. Their work further elaborated on the dyadic relationship and proposed a parent-infant feedback system that is continually adapting to stressors with the goal of self-regulation. For the infant, the early mother-infant interaction provides an opportunity for the infant to learn how to maintain stability when confronted with the physiologic demands of the interaction. As the infant gains physiologic control, there is greater ability to attend to the interaction. The mother's sensitivity to her infant's cues and her responses modulates the interaction (Brazelton, Koslowski, & Main, 1974). Therefore, early synchronous mother-infant interactions prepare the dyad for more complex and reciprocal interactions.

In describing synchrony, the emphasis is on the mother-infant dyad as an interactive system. How this system functions is influenced by the unique characteristics of the mother and infant and how each modifies his or her behavior in response to the other as illustrated in Figure 1. A positive synchronous interaction is characterized as adaptive, reciprocal, and flexible. Moreover, there is rhythmicity to the interaction as each member makes behavioral adjustments in order to maintain balance in the system (Barnard, 1987). Conversely, dyssynchrony represents a shift in the interaction towards disharmony but it is an important aspect of the interaction. The adjustment in behavior required by the dyad to repair dyssynchrony is a positive adaptive feature that provides the infant opportunities to develop the skills needed for social interaction (Tronick & Cohn, 1989; Biringen, Emde & Pipp-Siegel, 1997).

3. Methods

This descriptive, longitudinal analysis used the regularly occurring and necessary caregiving activity of feeding as the context to examine mother-infant synchrony. The data were

drawn from existing, de-identified data that were gathered as part of a study examining the effect of maternal feeding behavior on premature infants' physiologic regulation during feeding and its development over the infant's first four post-term months (Brown, 2007). The data came from 43 mothers who were videotaped while feeding their preterm infants at three intervals - before discharge in the nursery and then in their homes at 1 month and 4 months corrected age. Study participants were recruited from three nurseries in a large central city hospital and 2 smaller hospitals serving a mix of urban and rural areas in the Midwest. Eligibility included maternal age ≥17 years and the ability to speak and read English. Inclusion criteria for the infants were ≤ 35 weeks at birth, appropriate weight for gestational age, no major congenital malformations and no known drug exposure. Both breast and bottle fed infants were included. Infants with a Grade II intraventricular bleed or greater were excluded.

For this study a sample dataset from 10 mother-infant dyads that completed all three data collection points (30 observations total) were used. As this study used an existing data, expedited review and approval was obtained from the university institutional review board. Participant age in the sample dataset ranged from 20-42 years with 8 White and 2 African American participants. Educational background varied with five completing high school, four holding a higher educational degree and one participant unknown. Eight participants were married and two had partners but did not live with the partner. For six mothers, this was their first child. The infants weighed 722-2602 grams at birth with a birth gestation of 25-34 weeks. There were three males and seven females in the sample. Post-menstrual age (PMA) at time of discharge (first feeding observation) was 33-38 weeks. Length of hospital stay was 9-79 days (M = 42.6 days). Time on ventilator including continuous positive airway pressure, (CPAP) was 0-58 days (M=

18.1 days). Two infants were discharged home on oxygen by nasal cannula. Three of the mothers' breast fed their infants but only one infant was breast fed for all three observations.

As part of the original study, data were also collected on maternal depression as scored on the Center for Epidemiologic Study-Depression (CES-D) Scale and maternal responsiveness and sensitivity scored from the Positive Affective Involvement and Sensitivity/Responsiveness (PAISR) scale of the Parent-Child Early Relational Assessment (PCERA). The mother-infant dyads had also been scored for dyadic tension and reciprocity using the Dyadic Tension (DT) Scale and the Dyadic Mutuality and Reciprocity (DMR) Scale of the PCERA. For this analysis, additional scores for assessing severity illness using the Neonatal Medical Index (NMI) and for assessing infant behavior state using the Anderson Behavior State Scale (ABSS) were computed.

The CES-D, a 20-item scale assessing for depressive mood, feelings of guilt and worthlessness, feelings of helplessness and hopelessness, loss of energy and appetite, and sleep disturbances, was used to measure level of depressive symptoms (Radloff, 1977). Participants rate the frequency of symptoms over the past week ranging from "rarely or none of the time" to "most or all of the time." A total score is obtained by summing the item scores with a total score range of 0 to 60 and with higher scores indicating more depressive symptoms. For this study, CES-D scores for the three measurement points were, 13.9 (SD 10.48), 12.3 (SD 7.33) and 10.4 (SD 4.30), respectively.

The PCERA is a 65-item observational rating scale using 5-point Likert scales. It was designed to assess the amount, duration and intensity of adaptive parent and infant behavior. Item score of 1 and 2 are considered areas of concern, 3 is an area of some concern, and 4 and 5 are areas of strength (Clark, 1999). The PCERA contains six subscales which were theoretically derived and confirmed by factor analysis (Clark, 1999). Discriminate validity was demonstrated

by comparing healthy and high risk dyads (Clark, Hyde, Essex & Klein, 1997; Clark, Paulson & Colin, 1993; Grych & Clark, 1999). For this study, three of the subscales were used. The DT scale and the DMR scale examine the contribution of each member of the dyad to the interaction. The DT scale includes anger/hostility, tension, anxiety, and no joint attention or activity. The DMR scale variables are lack of flat/empty/constricted affect and enthusiasm/joie de vivre. The PAISR Scale examines adaptive maternal feeding behavior. It is a 16 item subscale that contains variables measuring a mother's sensitivity and responsiveness to her infant's cues. It includes how the mother structures and modifies the environment, genuine visual regard and mirroring of the infant's feelings. Alpha coefficient ranges for the scales assessed at the three data collection points were: DT 0.56 to 0.89, DMR 0.91 to 0.93, and PAISR 0.96 to 0.97. PAISR mean scores for the three measurement points were, 3.5 (SD 0.81), 3.3 (SD 0.83), and 3.1 (SD 1.06), respectively. The DMR scores were 2.8 (SD 0.86), 2.86 (SD 0.92), and 3.3 (SD 1.23), respectively. The DT scores were 4.46 (SD 0.30), 4.3 (SD 0.41), and 3.9 (SD 0.94) respectively.

The NMI was used to assess the biologic condition (severity of illness) of the infants. The NMI classifies preterm infants by summarizing their medical conditions. Classifications range from 1 for infants born weighing more than 1000 g and without major complications, to a score of 5 for infants born weighing less than 1000 g and with very serious complications. Infants in this sample were classified as either being a one, three or five. NMI scores are predictive of early developmental outcomes in preterm infants (Korner, Stevenson, & Kraemer et al, 1993).

The ABSS describes 12 states of activity and wakefulness in infants (Gill, Behnke & Conlon, et al, 1988). There are four measures of sleep, five measures of awake, and three levels of crying. Scoring involves observing the infant for the first 30-seconds of the feeding and then

determining the highest state that occurs. For this sample, the mean score at the three measurement points were, 6.2 (SD 2.25), 7 (SD 2.26), and 7 (SD 1.7) respectively.

4. Analysis

The Noldus Observer XT 8.0 software package (Noldus Information Technology b.v., 2006) was used for data review and behavioral coding. The Observer software allows the researcher to examine the data and code for predetermined events. Thus, the researcher can view the video and mark behaviors as either state events which are measured in seconds and thus represent duration, or as point events, which represent frequency. The software can also produce a chart in which the behaviors are represented with corresponding color bars, plotted horizontally against an axis representing elapsed time. The video can be visualized simultaneously with the marked behaviors and examined for relationships.

Descriptive statistics were used to describe the occurrence of infant and mother behaviors from which the MISS was developed. Behaviors having duration were considered state behaviors such as the amount of time the mother spoke to someone other than the infant or the amount of time the infant had his or her eyes open. The percentage of time the state behaviors occurred within each feeding were calculated, then summarized for each measurement (discharge, 1 and 4 months PMA), and examined for change over time. Behaviors that do not have duration such as touch or a disregulated swallow were considered point behaviors. The frequency of occurrence of point behaviors were calculated for each feeding, summarized for each measurement point and examined for change over time. To determine inter-rater reliability, a second person, trained to 80% reliability coding the MISS, coded a random 20% of the videos. Inter-rater reliability was demonstrated with a combined percent agreement of 83% (range 79-88%) and Kappa value of 0.82 (range 0.77-0.88).

The mediation effects of infant (behavior state, morbidity, birth gestation and birth weight) and maternal (depressive symptoms, responsiveness and sensitivity) characteristics, were tested using regression analysis. Infant and maternal characteristics were used to predict the MISS score.

Using repeated measures ANOVA, the MISS score was examined for changes over time. MISS scores were compared to the DT and DMR scores using correlation coefficients to test criterion validity. The correlations of scores across the three measurement periods were examined.

5. Results

The purpose of the study, to develop and test a coding system for assessing synchrony of feeding interaction was accomplished through a refinement of the Mother-Infant Synchrony Scale (MISS). The MISS is an observational assessment tool designed to assess three primary categories: mother behaviors, infant behaviors and engagement. Each category contains subcategories of behaviors. Seven subcategories comprise the mother behaviors, attention, support, verbal, feeding, tactile, vestibular and interaction. Infant behavior subcategories are attention, affect/tone, state, feeding, tactile, vestibular and interaction. The engagement category involves the mother and infant behaving simultaneously. These subcategories represent 48 possible behaviors that can be observed during a feeding observation. The behaviors included on the MISS were developed from the Mother Infant Feeding Tool (MIFT) which was designed to describe the very early feeding process between mothers and their very young infants (Brown, Thoyre, Pridham & Schubert, 2009). Each behavior within the MISS categories was assigned a value from one to four, depending on the frequency of occurrence or percentage of time the behavior occurred. A higher number represents a behavior considered to be positive and

supportive of the interaction, while a lower number reflects a behavior having a potentially negative impact on the dyadic interaction. The values assigned to the behaviors were determined from previous MIFT and MISS pilot data. The value for each behavior was calculated to obtain the total MISS score. Total possible scores ranged from 55 to 167.

A pilot study using a subset of three mother-infant dyads (nine videos), was completed to test preliminary behaviors and definitions derived from the MIFT. The nine videos were coded using the MISS; for interrater reliability, a random selection of the videos was coded by another trained reviewer. As a result, the definitions were further refined to best capture individual variations in behavior. Following completion of the pilot, 10 data subsets representing 30 feedings were coded using the revised MISS. Coding occurred continuously and in real time throughout the feeding with mother and infant behaviors coded in separate reviews. Each data subset reviewed a minimum of six times in order to thoroughly code for all behaviors. The MISS score was determined based on the results of the video coding and a composite MISS score given for each feeding observation.

5.1. Aim 1

The frequency of occurrence for select behaviors and the percentage of time certain behaviors occurred during the feeding and the change over the three observations periods are summarized in Tables 1 and 2. Mothers were generally attentive and focused during feedings and demonstrated positive maternal behaviors such as moving and repositioning their infants' with care and supporting their infants' position during the feeding. Mothers were primarily nonverbal and talked to their infants for 10% of the feeding across observations. Negative behaviors such as talking harshly to the infant occurred only once when an infant was choking and the mother sternly said, "breath." Mothers spoke to other people in the room for < 5% of the feeding and

there were no instances of harsh talk to others. Maternal touch was primarily gentle, accounting for 75-82% of all touch across observation points. Task touch, which has a functional quality and lacks tenderness, accounted for 17-23% of all touch and two mothers were observed touching their infants' in a rough manner (harsh or excessive patting or rubbing).

Infants generally fed with their eyes closed at the initial observation but by the final observation, eyes open accounted for 59% of the feeding. Infants showed subtle signs of disorganization (cry, fussy, not able to focus on feeding) which improved over time; however infants also became more active (i.e. squirming, twisting, repeated whole limb movement). Crying accounted for a very small proportion of the observation but also increased over time. Generally infants were regulated, feeding smoothly or receptive to feeding and quiet.

A dysregulated swallow (i.e. cough, gulp, stridor) occurred at least once in most of the feedings, with several infants having repeated occurrences. Interestingly, the occurrence of a dysregulated swallow peaked during the second observation with a dramatic decrease by the third observation. Head avert, or pulling away from the nipple occurred with increased frequency over time. However, infants demonstrated improved feeding behaviors over time. Infants were more ready for the nipple with fewer refusals, required less rooting to get the nipple in and there were fewer episodes of the nipple placed negatively by the mother. All mothers repositioned or pulled on the nipple during feeding to assess for continued sucking or prompt further sucking however, these behaviors also peaked at the second observation.

The number of times infants touched their mothers, purposeful or random increased over the observation period and although the amount of time spent gazing at their mothers was brief, the frequency increased. Attempts by the mothers to interact with their infants were minimal and the frequency did not change. Thus, engagement, with the mother and infant looking at each

other occurred rarely and was observed only in three dyads, accounting for less than 3% of the interaction.

The most frequently occurring behavior pattern involved the regulation of the feeding by the mother. Pulling on the nipple or repositioning the nipple occurred frequently before pulling the nipple out. Pulling and repositioning of the nipple were alternating behaviors occurring in sequence. Repositioning of the nipple occurred if the nipple was placed in the infant's mouth using some pressure and was not readily accepted by the infant. A dysregulated swallow typically occurred after sucking but it also occurred when sucking had stopped. Repositioning or pulling on the nipple did not precede a dysregulated swallow.

5.2 Aim 2

To examine mother-infant synchrony during feeding over the three observations, a repeated measure ANOVA was used; the MISS means are shown in Table 3. The ANOVA indicated that the means were not significantly different ($F(2, 27) = 2.75$, p 0.08). Using Tukey's HSD, it was determined with 95% confidence that there was no difference between observation periods one and three with a difference of 11.5 (CI -1.1, 24.4), one and two with a difference of 9.3 (CI -3.6, 22.2), or two and three with a difference of 2.2 (CI -10.7, 15.1).

5.3 Aim 3

To examine the mediating effects on synchrony by selected infant and maternal characteristics, birth gestation, birth weight, and the scores from the NMI, ABSS, CES-D, and PAISR were regressed on the MISS score for each observation. None of the selected mediators had any significant effect on synchrony at any of the observation points.

5.4. Aim 4

The DT and DMR results were used to test the criterion-related validity of the MISS. There was no significant correlation at the first observation between the MISS and DMR ($r = 0.42$, $p = 0.11$) or MISS and DT ($r = 0.25$, $p= 0.48$). At the second observation the MISS was positively correlated with the DMR ($r = 0.65$, $p= 0.04$) but not with the DT ($r = 0.11$, $p= 0.75$). At the third observation there was no significant correlation between the MISS and the DMR ($r = 0.16$, $p= 0.66$) or the MISS and the DT ($r = 0.48$, $p= 0.16$). There was no significant correlation of MISS scores across observations with $r=0.2$ for the correlation between observations one and two ($p= 0.59$), $r= 0.48$ for the correlation between observation one and three ($p= 0.16$), and $r=0.19$ for the correlation between observation two and three ($p= 0.59$).

6. Discussion

The synchrony tool developed in this study demonstrates that changes occur in mother and infant behavior over time. Despite that, the tool did not demonstrate concurrent validity with established measures, the DT and the DMR. One major difficulty in measuring synchrony is identifying and defining critical behaviors that are specific enough to capture the variations in individual behavior yet broad enough to account for maturational changes. Some behaviors can be considered positive or negative depending on the frequency of occurrence. “Head avert” or the infant pulling away from the nipple can indicate a lack of a mother’s attentiveness to her infant’s cues and ability to pace the feeding accordingly. However, “head avert” increased in occurrence at the second observation, perhaps indicating the infants’ stronger motor skills and ability to self-regulate the feeding. Mother behaviors such as, “support talk” or “gentle touch” are considered favorable, but if excessive can be intrusive to the infant. One mother gently touched her infant throughout the feeding and in response the infant paused in sucking, as if

distracted. Certain behaviors can be misleading such as coding the infant for "open eyes" which covers a spectrum from drowsy and heavy lidded to eyes wide open and luminous. Therefore, "open eyes" can only imply that an opportunity for interaction may exist.

The mother and infant interactive behaviors were particularly intriguing. One infant repeatedly glanced at his mother although she rarely returned his gaze. However, these attempts were less at the subsequent observation, perhaps as the infant was beginning to learn that this behavior was not going to be reciprocated or rewarded. Another mother-infant dyad was briefly "engaged" visually but then the mother went back to the task of monitoring the feeding despite her infant's continued gaze. Of note, throughout the observations, the infant attempts at interaction (gazing at mother) were greater than the mother attempts to engage her infant. Generally, the mothers' primary focus was on the task at hand – feeding. Approaching the feeding as a task instead of an opportunity for interaction may reflect the early feedings in the NICU with an emphasis on taking the prescribed volume in order to achieve discharge criteria. Particularly at the first feeding observation, mothers watched their infants' sucking intently but it is not known if they had a clear understanding of what they were looking for, other than continued sucking.

The influence of maturation on feeding behaviors is evident across observation periods. Mothers' use of excessive pressure to root or place the nipple in the infant's mouth declined and the number of times the infant readily accepted the nipple without rooting increased over time. Repositioning the nipple was a strategy used frequently by mothers to prompt continued sucking or to evaluate the strength of the infant's suck. This is supported by the pattern of repositioning the nipple or nipple pull followed by the nipple being removed from the mouth.

Infants less than 6 months of age are limited in their repertoire of interactive responses and the newborn period is primarily focused on physiologic regulation (Carlson, Sampson & Sroufe, 2003). Therefore, the assessment of mother-infant interaction frequently uses older infants and uses a play situation for the setting. Often, the assessment of synchronous behaviors or patterns is used to correlate with attachment behaviors measured in older infants and toddlers. Adding to the difficulty in assessing synchrony in young infants is that an interaction is not entirely synchronous. Tronick & Cohn (1989) examined the face-to-face interactions of infants at 3, 6, and 9 months of age using a coding scheme that identified combinations of expressive behaviors of the mother and infant during a play situation. They found that periods of dyssynchrony were much more common, with up to 70% of an interaction spent in a mismatched or dyssynchronous state.

Similar to the MISS, behaviors used in other tools designed to measure mother-infant interaction include maternal gaze, maternal affect, maternal talk and touch as well as infant affect and infant gaze (Feldman & Eidelman, 2007). The Dyadic Mini Code (DMC) is a tool designed to measure levels of synchrony in early interaction (Censullo, Bowler, Lester & Brazelton, (1986). This tool scores the interaction along six levels of engagement using global assessments. For example, positive affect was determined by how pleasurable the interaction appeared based on the facial expressions and vocalization of the parent and infant. However, the DMC was developed for use in a study with infants 3 and 5 months of age during a three minute play session with a parent.

The findings of this study are similar to those of Vandenberg (2006) in which synchrony between mothers and their preterm infants prior to discharge from the NICU was examined using two assessment scales to measure the quality of the interaction during a feeding. Results showed

that there was minimal synchrony demonstrated prior to discharge (< 15%). Mothers also had difficulty reading their infant's cues and although mothers watched their infants closely, there were minimal attempts at engagement.

The MISS tool is unique as it includes mother and infant behaviors specific to feeding which can be generalized to a non-feeding interaction. The MISS is also one of only a few tools designed to measure synchrony early in the development of the mother-infant relationship. However, the large number of behaviors measured with the MISS produced great variability in scores with a small sample size. The correlation of the MISS with the DMR at the second observation point was probably a chance occurrence given the lack of correlation at other measurement points. The MISS may have been too broad a measurement tool for the specific behaviors measured by the DMR and DT, which were not designed for feeding interaction. What may be most revealing about the interaction is the occurrence of engagement, mother interaction attempts, and infant gaze. In this sample, the low occurrence of these behaviors, particularly at the third observation when the infants were older is disturbing as developmentally this represents a period when infants have the ability to display more obvious interactive cues.

6.1. Limitations

The video recording of mothers feeding their infants poses certain technical challenges depending on the behaviors being observed. The angle of the camera was not always set so that the mother and infant could be visualized clearly. Observing infants at breast feeding was difficult because their face was often obscured by the breast. During burping, the infants were often positioned with their backs to the camera. Infant sucking was often difficult to distinguish from "chewing" on the nipple or a weak suck. Maternal behaviors may have been influenced by the observation camera, although this seemed less apparent when in the home setting. Gaze was

difficult to capture completely and required frame by frame review for analysis. Additionally, some of the videos had been edited to contain only the feeding interaction. However, it may be important to capture the interactive patterns that occur relative to the feeding, such as the period before the feeding and pauses for diaper change. It would also be helpful to know if the mother thought the observed feeding was a "typical" feeding. Finally, although having data available across three time points was invaluable; to develop an accurate measure of synchrony a larger sample size is needed. Including healthy term infants in further study would also be useful as the behavioral cues and the maternal responses would likely be easier to view and analyze.

6.2 Conclusion

There is increasing emphasis on the importance of the early mother-infant relationship as the foundation for the development of healthy interactions. Understanding the nature of the dyadic relationship and how the individual behaviors combine to form unique patterns of behavior is important. The results of this study revealed behaviors that are descriptive of the interaction and can be used to develop interventions that would support the developing relationship. Establishing normative indices for behaviors that occur during an interaction could be useful in evaluating high risk populations. It is evident that mothers need guidance and support while learning to feed their preterm infants. Feeding is an opportunity for the infant to learn what to expect during the interaction. Efforts need to be made to change the emphasis of feeding from a task to an opportunity for interaction.

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Table 1. Frequency of Occurrence for Selected Behaviors over Time

Behaviors	Observation 1 Total (Min-Max) Mean (SD)	Observation 2 Total (Min-Max) Mean (SD)	Observation 3 Total (Min-Max) Mean (SD)
Ready for nipple	31 (0-6)	46 (1-11)	60 (2-18)
	3.1 (2.1)	4.6 (3.3)	6 (4.9)
Refuse nipple	30 (0-10)	13 (0-8)	13 (0-11)
	3 (3.5)	1.3 (2.7)	1.3 (3.4)
Rooting negative	72 (0-49)	47 (0-32)	12 (0-9)
	7.2 (1.5)	4.7 (10)	1.2 (2.8)
Nipple in with root	23 (0-4)	10 (0-6)	9 (0-9)
	2.3 (1.5)	1.1 (1.9)	1 (0.7)
Nipple in without root	17 (0-5)	45 (1-11)	63 (1-18)
	1.7 (1.8)	4.5 (3.3)	6.1 (4.8)
Nipple in negative	25 (0-9)	13 (0-7)	9 (0-8)
	2.5 (3)	1.3 (2.4)	1 (2.5)
Nipple pull	60 (0-28)	79 (0-31)	51 (0-36)
	6 (9.2)	8 (11.8)	5.1 (11)
Nipple reposition	40 (0-11)	109 (0-44)	34 (0-12)
	4 (3.9)	10.9 (15.1)	3.4 (5)
Disregulated swallow	58 (0-26)	88 (0-58)	9 (0-3)
	5.8 (7.8)	8.8 (18.1)	1 (1.1)

Infant gaze	1 (0-1)	15 (0-9)	23 (0-10)
	0.1 (0.3)	1.5 (2.9)	2.3 (3.9)
Infant touch	1 (0-1)	20 (0-5)	43 (0-21)
	0.1 (0.3)	2 (1.8)	4.3 (6.8)
Mother attempt	3 (0-3)	4 (0-2)	3 (0-2)
	0.3 (0.9)	0.4 (0.7)	0.3 (0.7)
Engaged	1 (0-1)	5 (0-2)	3 (0-2)
	0.1 (0.3)	0.5 (0.8)	0.3 (0.7)

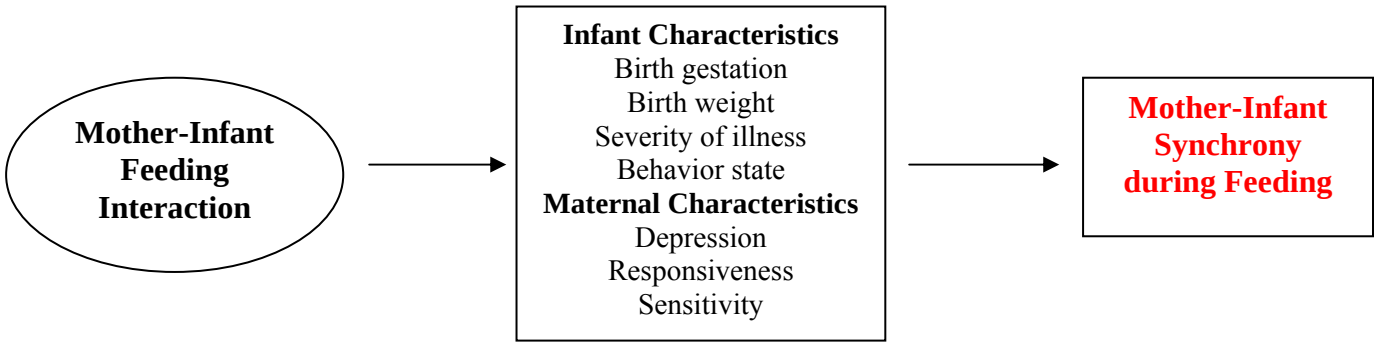
Table 2. Percent of Occurrence for Selected Behaviors over Time

Behaviors	Observation 1 Min-Max Mean (SD)	Observation 2 Min-Max Mean (SD)	Observation 3 Min-Max Mean (SD)
Regulated	56 – 95.8 79.2 (13.8)	77.4 – 99.5 90.7 (6.7)	65.5 – 99.6 92.1 (10.9
Disorganized	2.9 – 32 17.2 (12)	0 – 22.5 8.6 (6.8)	0 – 32 7.3 (10.4)
Quiet	69.1 – 99 90.3 (11.5)	57.3 – 96.9 78 (11)	30.1 – 98.6 68.6 (24.7)
Active	0 – 30.7 8.8 (11.6)	2.3 – 42.3 20 (11.4)	0.9 – 63.3 29.1 (23.4)
Crying	0 – 1.3 0.2 (0.41)	0 – 10.5 1.7 (3.2)	0 – 13.9 1.8 (4.5)
Support talk	2.6-32.6 10.7 (8.8)	1.2 – 38.9 9.4 (12.5)	0 – 35.83 9.7 (12)

Table 3. MISS Scores over Time

Time Period	Mean (SD)	95% CI	
Observation 1	123 (7.9)	117.4	128.6
Observation 2	131.9 (13.3)	122.4	141.4
Observation 3	134.5 (13)	125.2	143.8

Figure 1. Study Model



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Role: Co-Investigator

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