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Development of Early Social Interactions in Infants Exposed to Artificial Intelligence from Birth

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Program in Communication Disorders

Honors Thesis

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Abstract

Research suggests that technology density in a home may change interactions parents and infants in the earliest months of life. This study explored how the use of smart baby technology influenced parental perceptions of development and early social interactions. A qualitative, case methodology was used. The participants in this study were one family with newborn twins. Data was collected over a six month period using journals, field notes, and observations. Thematic coding of these materials was used to answer the questions of the study. Results suggest that use of smart technology supported the emerging parenting skills and allowed the parents to confidently establish care interactions.

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Development of Early Social Interactions in Infants Exposed to Artificial Intelligence from Birth

Research suggests that the density of technology in a home may change interactions that take place between a mother and infant even in the earliest months of development. According to Hutchinson, Nolan, and Weber (2009), a vital part of language acquisition in infants is connected to maternal responsiveness during mutual engagement. This research shows that when a mother is engaged in her child's play throughout infancy, an infant's first word as well as 50-word lexicon is developed at a quicker pace than children whose mothers are not responsive during play. Whether artificial intelligence (AI) helps or hurts the interaction shared between a mother and an infant is a controversial topic as many researchers say that AI toys delay the learning process of language in comparison to maternal responsive play, which supports imagination and creativity. However, many say there are significant benefits to the language learning process, as AI devices provide scaffolding (Hutchinson, Nolan, & Weber, 2009). Whether the alterations in interaction are positive or negative, the density of technology in homes is inevitably altering interaction patterns between mothers and their infants.

Artificial Intelligence

Devices using artificial intelligence are evolving day by day and minute by minute. Everyday life reflects this evolution as a 'smart' generation of children emerges in homes with smart TVs, phones, refrigerators, and even sleeping from birth in AI responsive bassinets (Happiest Baby, Inc., 2018). The term artificial intelligence (AI) was coined when John McCarthy and nine other men joined together at Dartmouth College to create machines that produce human-like characteristics. The idea was to create machines that could perform tasks that no human being had ever accomplished. Although McCarthy's original plan was not as successful as he hoped, his continued interest in AI and the evolution of technology motivated

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people to continue making advances in the field (Simonite, 2018). Now in the 21st century, AI is not just equipment in factories that can do assembly line work in the place of humans, but it is integral into home life and has become a natural part of growing up and developing for many infants and children. Winerman (2018) used the claim of Smith, a developmental psychologist, that babies are smarter than any machine created today. He used this claim to learn more about how to develop artificial intelligence or smart devices through exploring the brilliant brains of infants.

Technology, Development, and Caregiver-Child Interaction

Simonite (2018) is one among many who suggest that the prevalence of AI may be affecting children's development in not yet recognized ways. Some theorists argue that technology diminishes the rate of development of language in children, while others have explored the idea of how technology encourages language acquisition and development in the first years of life. This review explores both perspectives.

Watt (2010) claims that human interaction is crucial in infant language acquisition. This being the case, he theorizes that the amount time that infants and children are immersed in artificial intelligence devices could be taking away important characteristics of language that are embedded in mother-child interaction. He supports this by referring to data that shows when density of technology is high in a home, the number of social interactions is statistically lower for children in this home. Watt believes that activities significantly benefitting language acquisition, like face-to-face social communication skills within the family, are often overshadowed by technological devices, creating social isolation. There is some evidence that there may be a relationship between early social isolation and degree and kind of technological density in the home. Watt relates this to the language development, specifically pragmatics,

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which depends on attending to nonverbal cues, contextual language use, turn-taking, relevance, and formality levels. Since these linguistic characteristics are learned through social interactions that may be non-verbal as well as verbal, his point is that they may not be as sufficiently developed in children growing up immersed in AI than those of children growing up without the direct influence of technology. This would be the case, he suggests, even when the vocabulary of both sets of children are the same or when that of the child embedded in technology is more expansive (Watt, 2010).

While believing that technology diminishes the rate of language learning, Watt did acknowledge that researchers using Piaget's methods found that artificial intelligence does not help or hurt the acquisition of language and speech. Piaget's theory states that children build their own language through independent, direct, and active exploration of the world around them through play and curiosity. Papert (1980), who studied under Piaget and adopted his theories, explored how computers may affect language and children, as he realized that American society even in the latter part of the 20th century was in a technological revolution that would lead to widespread changes in daily life. Through his rigorous research, Papert found that computers make it possible for the environment in which children are learning to be manipulated by the child directly.

Other researchers, such as Hannafin and Land (1997), used both Piaget's theories and sociocultural theories to examine technology-enhanced learning environments. Their claim states that advances in technology enhance student centered learning and may even shift the learning process. Rogoff (1990) contrasts Piaget's age-stage theory of intellectual development with an approach to cognitive development grounded in social contexts. Her point is that participation in cultural activities, which may vary by nation-state or family system, is key to

cognitive development because these activities ground communication and facilitate interdependence, which in turn transform development. While Rogoff did not explore technology at the level of AI devices, her theoretical assumptions and extensive observational reports validate the importance of interaction between caregivers and children as fundamental regardless of the technology present.

Home Technology and Infant Development in the First Six Months

Over the first six months of life, infants adjust to life outside the womb and parents adjust to the needs of an infant who begins life without the tools for intentional communication. This is a special time in the life of both the infant and the parent as the biological drive to bond is augmented by the routines of everyday life. Today, many ‘tools’ are used in homes to accomplish this by impacting the emerging, socially situated communication of the infant. When smart technology is one of those tools and it is used for a basic daily life necessity, e.g., sleeping and eating, there is the possibility that parent-infant-parent communication will be changed.

The Snoo is a technologically advanced bassinet designed for infants 0-6 months old that reportedly contributes to better rest for parents. Dr. Harvey Karp designed the Snoo to aid infants’ sleep, which in turn aids parental sleep. This smart sleeper has speakers and microphones that hear an infant’s cries and react with a rocking motion and white noise that mimicks what infants experience in the mother’s womb. These coordinating movements and sounds intensify when the infant’s cry persists or becomes louder, and they diminish when the infant is calmed. The Snoo’s custom designed sleep sack keeps infants on their backs by way of a swaddle sack that fastens to the bed on each side to keep the infant in the same position throughout their sleep cycle (Happiest Baby Inc., 2018). The bassinet connects to an app that is downloaded on an iPhone or iPad that alerts parents’ technological devices when an infant is

awake. It also lets them know when perhaps they are in need of parental care so they can check if it might be time for a feeding or a change. According to Knap in a social media posting, an additional benefit of using the Snoo is a better quality of life for parents resulting from better rest rather than alerting to every movement initiated and sound produced in the infant (Happiest Baby, Inc., 2018).

Summary and Questions of the Study

Research with and on the development of artificial intelligence began as early as the 1950s, but it is only in the last 5 years that it has become commercially available in homes in the form of personal products, home efficiency products, and even toys for young children (Simonite, 2018). As a result, everyday life is now AI enabled. Information about AI devices that learn from the user and predict the next moves and needs for this user were the backdrop for this research. In particular, this information raised a question about how AI might yield a different experience in social and interactive life for infants that have been exposed to AI from their earliest days. The first phase of the study used public sources to gain insight on the use of AI infant technology. The second phase was designed to gain insight from parents using technology over the first six months of infancy that could address the specific questions of the study and allow for discussion in relation to the literature reviewed.

The specific questions of the study are:

1. In what ways did the use of smart baby technology change the perceptions of parents about their infants' development?
2. In what ways did the use of smart baby technology change interactions among mothers, fathers, and the infant?

3. In what ways did the use of smart baby technology change the perceptions of parents about the interaction between family members and their developing infant?
4. In what ways were the perceptions of ‘parenting with AI assistance’ impacted by the routine use, density and diversity of technology in the home?

Methodology

Phase One – Preparatory Study

The preparatory study was an initial phase of the research project designed to determine from public sources who uses the Snoo bassinet and why they are using it. The materials used in the preparatory study were publicly available blogs, parent-written articles, and YouTube videos selected for variety of source, family constellations, and socioeconomic status. Coding conventions consisted of describing the setting, type of narrative, and occasion of the materials and transcribing video material using the categories of parent life, home life, and home technology density.

The following information was synthesized from the materials involved in the preparatory study through four key concepts that were analyzed: Parent perspectives on the use of the Snoo, parenting experience (first child vs. second or third), impact of the Snoo on home life and daily routines, and downsides of the Snoo. From a parent perspective on the use of the Snoo, parents mentioned that the Snoo put their baby to sleep, helped the baby stay asleep, soothed the baby when he/she was fussing, and acted as a night nurse for the baby. When we investigated parents’ experiences associated with the use of the Snoo, parents said that the Snoo made the transition to motherhood easier, reduced anxiety after the birth of their second child, comforted them by assuring them that the baby was safe while sleeping, and gave them time for other family members. However, it did take time for them to adapt to the bassinet’s responsibility

to the infant. In the materials analyzed for preparatory study, we found that the Snoo greatly impacted home life and daily routines for families. It allowed time for maintaining routines, it was a natural addition to technologically dense homes, it reduced parent guilt and anxiety, it allowed parents to become relaxed sleepers, it created a work/life balance, and it made it easy to swaddle the baby in the Snoo sleep sack. The downsides mentioned by parents about the Snoo were that the bassinet was costly, it was only developmentally effective for 6 months of the infant's life, there was a need for special bedding that changed as the infants grew, it was difficult to transport for weekends away (resulting in loss of routine during travels), and challenges were faced with the high-tech nature of the Snoo (connectivity and set-up).

After synthesizing this information, it appeared that in the families that successfully set up the bassinet, it was easy to use and did contribute to better quality of home life and sleep. These impressions were then used to refine the questions of the study for the second phase.

Phase Two – Twin Study

Participants

Families were sought through nomination for the second phase of the study. They were screened for internet access in their homes and willingness to upload an app that linked to the Snoo, maintain a home journal, and participate in monthly home visits from the researcher until the bassinet was no longer used. During recruitment, a family expecting twins volunteered to participate. A review of the use of the Snoo with twins yielded online personal testimonies of the usefulness of the Snoo with twins; however, no data or other studies were available.

Therefore, it was decided that the study would take advantage of this rare opportunity to research a family with twins. Both parents were college educated and lived in the Northwest Arkansas area. The infants born into the study family arrived at 28 weeks and 2 days gestational age on

November 4, 2019. Baby E weighed 2 lbs. 12 oz., and Baby Y weighed 4 lbs. 0 oz. Both infants were placed in incubators in the NICU, where they remained for 72 days. The infants were discharged to go home at 10 weeks and 2 days of age.

Materials

The materials for this study included two Snoo bassinets, Snoo sleep sack swaddles of various sizes, Snoo sheets, a pre-study and post-study home technology and values questionnaire, and a parent journal that was recorded via Microsoft Office OneNote. The Snoo app was used for sleep logs and alerts for each infant. Only one bassinet could be linked to a single phone, so each parent had a link to one of the bassinets. The researcher used her computer for observations and field notes during home visits with code names to keep information confidential. Materials added over the course of the study included leg extensions for both bassinets at the request of the parents as both infants to different degrees were experiencing reflux. The family also provided information through text messages, pictures, and video clips during the COVID-19 pandemic to substitute for the last two in-person home visits.

Procedures

The family was contacted after nomination six months into the pregnancy. Explanation of the study took place and all the consent forms were signed at the first meeting. The family was given informational material about the Snoo (AI) bassinet and the pre-study home technology and values questionnaire, which was completed and returned to the researcher. Data collection began immediately with parent journals that continued throughout the study. A Snoo bassinet was provided to the family for each infant at the time of their request, which was approximately one month before the estimated birth date of the expected babies so that the

family could integrate the Snoo bassinets into the home environment and infant space before their birth.

Since the infants were expected to be premature, the parents completed a home technology and values questionnaire at the time they agreed to participate in the study and again at the end of the study. They maintained and provided weekly reflections to the researcher on parenting, development, communication, and daily routines with the infants/parents/family while the Snoo was in use. The researcher made phone contact with the family weekly and completed monthly home observations, during which time a semi-structured interview was used to capture impressions about the infants' development and social engagement. The parents also kept a journal on daily routines, development, sleep patterns, social communication patterns, etc. via Microsoft Office OneNote that was shared with the researcher and could be accessed at any time.

Analyses

A qualitative, case methodology was used in this study. Data was segmented into three phases for analysis: Phase I – NICU; Phase II – Home and Introduction to the Snoo; Phase III – Daycare. A fourth phase was planned, but due to the COVID-19 pandemic, no additional data was forthcoming because of the mandatory termination of in person home visits. Fifty pages of materials from all of the sources were available for analysis of parent perceptions. Thematic coding utilizing Bowlby's (1969) early infant behaviors to elicit social contact and Stern's (1977) communicative sequences were used to answer the questions of the study.

Results

Question One

The first question of this study asked about the ways in which the use of smart baby technology changed the perceptions of parents about their infants' development. Regarding

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question one, parent perceptions of development were not changed by use of the Snoo. They began reading about infant development at the beginning of the pregnancy and shifted to reading about development in twins once that piece of information was identified. The interdisciplinary NICU team and the infants' pediatrician also provided information on development in premature infants, so the parents possessed a rich understanding of development prior to the twins' NICU discharge. Over the months of the study, they took pleasure in milestone achievements and appreciated the individuality of each twin. The following data points obtained from home visit transcripts and parent journals highlight important milestones and perceptions on the twins' development.

- “Their noises are more focused—they have slightly different cries for different problems and coo when they are happy about something.”
- “They started smiling this week. It’s helpful to start getting feedback from them in the form of smiles.”
- “They both tend to look to Mommy and Daddy when meeting new people to make sure they are safe.”
- “They are lifting their heads up very well, and Baby Y rocks herself like she is trying to roll over.”
- “They can see contrasting objects and will stare at them for some time.”
- “They are starting to attenuate to sound.”

The themes of raw development comments found from the above information do not allude to any conclusions that technology has changed perceptions of development. As far as the individuality of Baby E vs. Baby Y, the following comments from home visit transcripts and parent journals highlight the parental appreciation for the individuality of each twin.

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- “Baby Y is happy, friendly, fussy and messy. She can be quite alert and reactive and seems more outgoing. She has a hard time getting to sleep often and likes to be the center of attention.”
- “Baby Y has become cranky when she wakes up from a nap or nighttime sleeping. She fusses and whines a bit until she gets her bottle. Then, after the feeding, she is much happier and will give you the smiles and coos.”
- “Baby E is more particular – when she fusses there is usually a good reason. She prefers being in control and is more cautious – for example, she doesn’t care for the higher speeds on the Snoo or the swing, whereas Baby Y is soothed by them. She may not appear as alert or reactive as Baby Y, but you can tell she is very observant and is processing what you are doing. I think she is more introverted but has a lot going on in her head.”
- “Baby E is happy when she first wakes up and gives you the smiles. But if you take too long with her diaper change and getting the bottle ready she becomes fussy. She also gets fussy when she’s overly tired and trying to go to sleep.”
- “Baby E still sleeps a bit more than Baby Y, but when Baby Y starts doing something new, usually within a week Baby E starts doing it too.”

Question Two

The second question of this study asked how the use of smart baby technology changed interactions among mothers, fathers, and the infants. Regarding question two, the use of the Snoo did impact the parents’ interactions with the infants. The parents were comfortable with the Snoo and individualized the settings of the bassinets to respond in a way that best suited each infant. Data points from the parent journal illustrate this. Baby Y was described as a fussy

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infant who rouses easily and doesn't self-soothe. Rather than maintaining the highest setting at level 2, they let the Snoo automatic function take control, leading to higher settings.

- “Tonight we removed the motion limiter, and Baby Y went up to level four. Low and behold, she was soothed!”
- “New noises are distracting to her, and the lack of the Snoo's white noise when she sleeps at daycare makes it hard for her to go to sleep.”
- “She is getting used to the Snoo and the routine, so she anticipates what will be happening when she is put in the Snoo.”

A field note from an early home visit gives insight to the parents' appreciation for the Snoo's functions as a part of parenting interactions:

- “Level 4 soothing for Baby Y works wonders. If I did not have the Snoo, it would be much different because of her sensitivities and complicated sleep, wake, and eating cycles.”

Lastly, since only one bassinet could be linked to a single phone, each parent received data and alerts for one infant. The parents set up a system for who would attend to the infants regardless of which phone alert went off. This allowed them to work in tandem to meet the needs of the infants, still get rest, and adjust support for one another as needed.

Question Three

The third question of this study asked how the use of smart baby technology changed the perceptions of parents about the interaction between family members and their developing infant. Data points from home technology and value questionnaires, parent journals, and home visit transcripts were used to answer this question, as well as researcher's observations and structured dialogue conversations.

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Regarding question three, the use of smart baby technology did change the perceptions of parents about the interaction between family members and their developing infants. Extended family members included grandparents and an aunt with an infant six months older than the twins as well as a 2-year-old. Field notes and parent journal entries included reports and reflections on how these family members interacted with the infants, the parents, and the Snoos. The perceptions of the grandmothers differed in part because one lived locally and was involved in the home routines, including use of the Snoo, from the time the infants came home, while the other was exposed in a visit. The following data points came from home visit transcripts and parent journals regarding interactions between the infants and family members.

- “Baby E was being held by her grandfather. When he held her, she studied his face and looked back and forth between her parents and grandfather. She turned her head in the direction of her mom and dad when necessary to ensure that she was safe.”
- When the mother’s sister brought her two young daughters (ages 6 months and 2 years) to meet the infants, the mother made the following observation: “When Baby E and Baby Y’s six month old cousin met them, she was very interested. When one of the infants began to cry, the cousin began looking at her mother with sad eyes and a frown. Her mother then assured her that the infants were going to be alright but maybe they were hungry or needed a change.”
- “They do seem comfortable with both of their grandmas, as they have spent a good amount of time around both of them.”
- “They both have begun to recognize when they are not being held by Mom or Dad. When the infants’ aunt held one of them, she studied her aunt’s face and held her eyes

very wide as if she was trying to figure out why she looked like her mom but didn't sound like her."

Question 4

The fourth question of the study asked how the perceptions of parenting with AI assistance were impacted by the routine use, density, and diversity of technology in the home. Home technology and value questionnaires, parent journals, and home visit transcripts were used to answer this question, as well as researcher's observations and structured dialogue conversations.

Regarding question four, this technologically savvy family came into the study with an appreciation and understanding of the possibilities for AI technology. The Snoo was successfully integrated into the routines of the household, and the parents easily managed moments when technology did not work as expected. They also added smart technology from the wide array of new products designed for babies, one of which was an instant formula maker, which allowed more efficient production of bottles.

- "The automatic bottle maker (Baby Brezza) is starting to make the infants 'impatient' for the bottles, so when the parents have to heat up bottles of breast milk instead of automatically making formula bottles via Baby Brezza, the infants cry until the bottle is ready for 3 minutes." While the babies are crying, the parents are interacting with the infants in ways that are described as follows: "It's usually us holding them and patting their backs saying it's only 2 more minutes...1 more minute..." "You know we are going to feed you, we do not let you starve." "Baby Y, you are being dramatic but we are making your bottle going as fast as we can. You are going to get your milk."

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In addition to acquiring several AI technology devices in addition to the Snoo throughout the process of parenting twin infants, the parents also acquired several pieces of low technology that they described as helpful for daily home routines in home visit transcripts, parent journals, and phone conversations. Data points are as follows.

- “We have a baby wipe warmer that helps make the diapering routine less miserable for the hungry and cold infants.”
- “Before the swaddle, we were having a rough time when we put them into the Snoo sleep sack, so we got the ‘Nested Bean’ sleep sack with a weighted area on the chest. We will try sending this to daycare. It seemed to help with Baby Y.”
- “We have other low-tech products that are innovative and help tremendously as well. These include a nose frieda to de-congest the babies’ noses, a pacifier that allows a syringe to be inserted for medicine delivery, and a diaper genie that makes diaper disposal much more convenient. We also just purchased a used ‘Table for 2’. It is 2 molded seats side by side that allow one person to feed two babies at the same time. This will take some adjustment as the girls are used to taking their bottles via a side streaming technique, and the ‘Table for 2’ is designed for normal ‘cradle’ feeding. It also does not facilitate burping two babies at once. However, I can see how this will be incredibly helpful when they are holding their own bottles.”

Discussion

The purpose of this study was to investigate how smart technology shaped early social interactions between infants and their parents in the first year of life. Our evolving understanding about how families are using AI devices, which learn from the user and predict the next moves and needs for this user, framed this research project.

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There were two phases of this study, both the preparatory study and the twin study. During the preparatory phase, blogs, videos, articles, and reviews of the Snoo bassinet were observed and synthesized for common themes associated with perceptions in parenting, daily routines, and communicative development. This preparatory phase of the study took place before Baby E and Baby Y were born to the time they spent in the NICU before home visits could be performed. We were able to become familiar with common beliefs, facts, and opinions on the Snoo and how it affects or does not affect family routines and infant communicative development. From the preparatory study, it was evident that parents were pleased with the Snoo for many reasons. They were pleased with its ability to put their babies to sleep and keep them asleep, as well as soothe their babies. The Snoo affected parents by making the transition to motherhood easier, reducing anxiety by keeping the infants safe during sleep, and creating time for other family members and children. It affected daily life routines by initiating time for maintaining routines, allowing more parental sleep, maintaining work/life balance, and more.

After the twins were able to leave the NICU and be introduced to the Snoo in the home environment, home visits began and parent journaling continued. The parents of this study shared many rich pieces of information on their infants' sleeping and eating habits, daily routines, communication and interaction patterns associated with development, and perceptions that accompany being new parents. As the babies grew and developed, it became evident that both biological and social development come into play together as time goes on because infants learn about and engage with the environment that surrounds them.

The results of this qualitative study suggest that the perceptions of parents about infant development were not changed by use of the Snoo. The Snoo did impact parent interactions with the infants as its use provided them with data about sleep, wake, and agitation that aided in care

routines. Parental comfort with their responsiveness to the infants increased as family life adjusted to meeting the needs of the newborns twenty four hours a day, seven days a week. When the parents' comfort was compared to that of the extended family, a positive attitude shift emerged as the Snoo's monitoring function was recognized.

Multiple sources of documentation were available in this data collection. The researcher used a narrative approach to analysis that incorporated well established research on infant communication (Bråten, 2008; Stern, 1977; Trevarthen, 2019) and patterns of social awareness (Bowlby, 1969), and these methods were efficient for managing the data. Research suggests that the density of technology in a home may change interactions that take place between a mother and child in the earliest months of development. The Snoo supported the emerging parenting skills of these parents, perhaps because they were users of technologically advanced devices prior to the birth of their twins. Studies of technology exposure with twins is rare, and it is non-existent with smart infant technology. The perceptions of the parents suggest that having this technology allowed them to establish care interactions with more confidence.

Limitations of the Study

There are limitations associated with this study. The first limitation was the the inclusion of only one family. The study was not originally planned for premature infants or twins. The findings were also limited by the unique circumstances of being first born children who arrived prematurely. Lastly, the last two months of this study were conducted remotely because of the COVID-19 pandemic, which brought forth new and unprecedented limitations that the researcher had to adjust to in the final phase of the data collection. These two components may have impacted the results and certainly limit any broad conclusions.

Future Directions

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Future directions could include the study of full term singletons as well as families with less technological expertise. At the same time, utilizing control families that do not use the AI bassinets would allow for broader interpretations of material. Lastly, additional smart technology devices to use with infant may be available for future studies. This would allow for comparisons and contrasts of the technological features that might impact early social interactions.

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Appendix A

Parent/Family Technology Questionnaire

1. Please tell us about your family.
 - a. Who lives in your home? (Check all that apply.)
 - both parents
 - single parent
 - children
 - 1-2 children
 - 3-4 children
 - more than 5 children
 - other family members
 - 1-2 family members
 - 3-5 family members
 - more than 5 family members
 - b. If there are children in your home, what are their ages? (Check all that apply.)
 - below 1 year
 - 2-3 years
 - 4-6 years
 - 7-10 years
 - above 10 years
2. Do your children attend school? Yes No N/A
If they attend school, is technology used there? Yes No
3. What is your highest level of education?

<input type="checkbox"/> GED or High School	<input type="checkbox"/> College Degree
<input type="checkbox"/> Technical College	<input type="checkbox"/> Advanced College Degree
<input type="checkbox"/> Some College	
4. Select which term best describes the community in which you live.

<input type="checkbox"/> Urban	<input type="checkbox"/> Suburban	<input type="checkbox"/> Rural
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5. How do you use technology? The table below may help you describe this.

Development of Early Social Interactions

SMART DEVICES USED IN THE HOME	WHAT IS THIS DEVICE USED FOR?	LOCATION IN THE HOME	HOW OFTEN ARE THESE USED IN THE HOME PER WEEK?
AMAZON ALEXA	Voice Assistants [] None [] Other [] List any other that apply:	Check all that apply. Family Room [] Kitchen [] Bedroom (s) [] None [] Other [] List others that apply:	____ hours/week
NEST SMART HOME DEVICES	Voice Assistants [] None [] Other [] List any other that apply:	Check all that apply. Family Room [] Kitchen [] Bedroom (s) [] None [] Other [] List others that apply:	____ hours/week

Development of Early Social Interactions

SMART PHONES	<p>Voice Assistants []</p> <p>None []</p> <p>Other []</p> <p>List any other that apply:</p>	<p>Check all that apply.</p> <p>Family Room []</p> <p>Kitchen []</p> <p>Bedroom (s) []</p> <p>None []</p> <p>Other []</p> <p>List others that apply:</p>	<p>___ hours/week</p>
<p>PERSONAL DEVICES-</p> <p>iPads, Fitbits, Game systems, etc.</p>	<p>Voice Assistants []</p> <p>None []</p> <p>Other []</p> <p>List any other that apply:</p>	<p>Check all that apply.</p> <p>Family Room []</p> <p>Kitchen []</p> <p>Bedroom (s) []</p> <p>None []</p> <p>Other []</p> <p>List others that apply:</p>	<p>___ hours/week</p>

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PERSONAL COMPUTERS	Voice Assistants [] None [] Other [] List any other that apply:	Check all that apply. Family Room [] Kitchen [] Bedroom (s) [] None [] Other [] List others that apply:	___ hours/week
SMART TOYS	Voice Assistants [] None [] Other [] List any other that apply:	Check all that apply. Family Room [] Kitchen [] Bedroom (s) [] None [] Other [] List others that apply:	___ hours/week

Appendix B

Informed Consent

Title: Development of Early Social Interactions in Infants Exposed to Artificial Intelligence from Birth

Researcher(s):

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Administrator(s):

Ro Windwalker, CIP
 Institutional Review Board Coordinator
 University of Arkansas Research Compliance
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Description: The purpose of this study is to investigate how smart technology in the home may be shaping social interactions between infants and their parents in the first year of life using a Snoo baby bassinet. As a participant, you are being asked to complete a brief a home technology and values questionnaire before and after the bassinet's use. The observations will be completed by you, the parent, reflecting on your infant's development and interactions with you and other family members. Weekly phone calls will take place where I, the researcher, will check in with you (participating families), as well as monthly visits in which you (participating family members) will share information you're your reflection journal and I will capture impressions about the baby and the crib. Observations will not be recorded.

Risks and Benefits: There are no known risks associated with this study. The study may increase our awareness of how artificial intelligence surrounding young infants in homes contributes to the development of social interactions between infants and their parents.

Voluntary Participation: You can decide any time that you and your child would like to withdraw from the study, and the information gathered thus far will not be used.

Confidentiality: All information will be kept confidential to the extent allowed by applicable State and Federal law and University policy. Code names will be used for all data collection and no identifying information will be used in any publication or report resulting from this research.

Right to Withdraw: Your participation in this research is completely voluntary. You are free not to participate in the project and to withdraw from the study at any time.

Informed Consent: (please print)

I, _____, have read the description, including the purpose of the study, the procedures to be used, the potential risks, the confidentiality, as well as the option to withdraw from the study at any time. Each of these items has been explained to me by the investigator. The investigator has answered all of my questions regarding this study, and I believe I understand what is involved. My signature below indicates that I freely agree to participate and have my child participate in this study and that I have received a copy of this agreement from the investigator.

I agree to participate in this study.

Yes No

I agree to allow my child to participate in this study.

Yes No

Signature: _____ Date: _____

Appendix C

First Contact Telephone Script**Project Title: Development of Early Social Interactions in Infants Exposed to Artificial Intelligence from Birth**

My name is Anna Vest, and I am a junior Honors student completing a degree in Communication Disorders at the University of Arkansas in Fayetteville. Thank you for contacting me about my study.

As the person who gave you my contact information may have said, I am fulfilling my honor's requirements by conducting research project. This study, which will last about 7 months, investigates how technology, particularly smart technology in the home, may be shaping social interactions between infants and their parents in the first year of life.

The families in this study will be provided with a Snoo baby bassinet that uses a smart phone app to alert parents when their infant is fussing and cannot be soothed with the built in rocking and quieting sounds. You would have the use of the bassinet for seven months, which would begin one month before your due date and extend until the baby is six months old. At the beginning of the study, we would ask you to complete a home technology and values questionnaire, and this would be completed again when the bassinet is returned. During the time you have the bassinet, we are asking that you keep a parent journal of reflections on your infant's development and interactions with you and other family members. I will call you weekly just to check in, and I will come see you once a month in your home so we can share your journal and capture impressions about the infant and the bassinet.

Please know that if you decide to participate in this study, there will be no identifying information about, your infant, or the family when I am writing about or presenting the results of the study. If you begin the study but decide not to continue, that is fine. In this case, I would pick up the bassinet and not use any information that you've provided.

Do you have any questions? If not, we can set up a time to meet. Before that meeting, you might want to get a better idea of the bassinet we would be using. Here's a link to the website: <https://www.happiestbaby.com/>. It talks all about the bassinet, and here is a place on the website that shares information about FDA approval: <https://happiestbaby.zendesk.com/hc/en-us/articles/231544347-How-has-SNOO-been-tested-for-safety->.

Appendix D

Semi-structured Dialogue for Home Visits

The home visits of this study will last from 30-45 minutes and consist of three phases: greeting and general talk, data collection questions, and wrap-up that will include any follow-up questions the family may have for the researcher and the scheduling of the next visit. The visit will be a conversation between the researcher and the family that focuses on the use of the AI crib, the infant-parent interactions from a developmental perspective, and a sharing of insight that the parents/family may have about the use of the crib as part of their live routines.

Phase I – Greeting

Thank you for letting me visit with you today. I've so looked forward to this visit. I will be taking notes as we talk if that's okay.

1. How are things going?
 - a) Is the baby doing well?
 - b) Is the household adjusting to the new member?
 - c) I love to hear stories, tell me something that stands out as special.
2. Is the crib working out for you and the family?

Prompts:

- a) Is it what you expected?
- b) In what ways are you using the features of the crib?
- c) Tell me about what works for you and what doesn't.

Phase II– Data Collection Questions

Babies develop so quickly. I'd love to hear about how your little one is changing.

3. Is your baby into a schedule yet?
4. Is s/he sleeping well?
 - a) Hard to get to sleep?
 - b) Wakes up at night?
 - c) Easy to get back to sleep? How do you do this?
5. How often does s/he eat? Does s/he let you know when she's hungry (and if yes, how)?
6. Tell me about ways that your little one is interacting with you and family members.

Prompts:

- a) Does your baby smile as a reaction to the parents' voice?
 - b) Does your baby make eye contact with you as you interact with him/her? If so, how long does your baby maintain this eye contact before looking away?
 - c) Does your baby turn his or her head towards you) when you speak to him/her?
 - d) Does s/he have a 'favorite' person? How do you know...tell me about it.
7. Tell be about how your little one is communicating

Prompts:

- a) Is your baby making any sounds? Using these to get your attention?
- b) How about body movement? Waving hands, feet, total body?
- c) Let you know when s/he wants something?
- d) What is your baby's favorite time of the day? How do you know this?

Phase III – Family's Questions and Scheduling

Appendix E



To: Anna Ellis Vest
From: Douglas James Adams, Chair
IRB Committee
Date: 09/17/2019
Action: **Expedited Approval**
Action Date: 09/17/2019
Protocol #: 1904194500
Study Title: Development of Early Social Interactions in Infants Exposed to Artificial Intelligence from Birth
Expiration Date: 04/28/2020
Last Approval Date:

The above-referenced protocol has been approved following expedited review by the IRB Committee that oversees research with human subjects.

If the research involves collaboration with another institution then the research cannot commence until the Committee receives written notification of approval from the collaborating institution's IRB.

It is the Principal Investigator's responsibility to obtain review and continued approval before the expiration date.

Protocols are approved for a maximum period of one year. You may not continue any research activity beyond the expiration date without Committee approval. Please submit continuation requests early enough to allow sufficient time for review. Failure to receive approval for continuation before the expiration date will result in the automatic suspension of the approval of this protocol. Information collected following suspension is unapproved research and cannot be reported or published as research data. If you do not wish continued approval, please notify the Committee of the study closure.

Adverse Events: Any serious or unexpected adverse event must be reported to the IRB Committee within 48 hours. All other adverse events should be reported within 10 working days.

Amendments: If you wish to change any aspect of this study, such as the procedures, the consent forms, study personnel, or number of participants, please submit an amendment to the IRB. All changes must be approved by the IRB Committee before they can be initiated.

You must maintain a research file for at least 3 years after completion of the study. This file should include all correspondence with the IRB Committee, original signed consent forms, and study data.

cc: Fran W Hagstrom, Investigator