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Contributions of Caregivers Interaction to Infant Attention

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CONTRIBUTIONS OF CAREGIVERS INTERACTION TO INFANT ATTENTION

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by

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ABSTRACT

Research shows the way adults communicate with children can be classified into two main categories: *Adult Directed Speech* (ADS) and *Infant Directed speech* (IDS) (Schachner & Hannon, 2011). Past research focused on the maternal use of IDS; however, the current study investigated differences in maternal and paternal use of IDS. We hypothesize that 1) there will be a difference in the amount of paternal caregiving depending on mothers' work status, 2) the acoustic properties of IDS will be influenced by the amount of parental involvement in caregiving activities, and 3) infants will pay more attention to parents who use more exaggerated IDS. No changes were found for paternal involvement when mothers were employed compared to when mothers were not employed. No relationships were found between IDS, parental involvement, or infants' attention. These findings provide a better understanding of fathers' contributions in caregiving and their influences on infants' cognitive development.

INDEX WORDS: Infant Direct-Speech, Infant Attention, Paternal Involvement, Caregiving

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The ability to communicate through words seems inherent to human beings. Language allows people to communicate their thoughts and convey their emotions. Many studies have been conducted to pinpoint how children learn languages. According to Whorf (1956), learning a language equates to learning to think in that language. Pinker and Kitzinger (1994) on the other hand, claimed that infants can use their cognitive ability to think through images and abstractions before they start to talk. Other findings suggest that the unique type of speech register parents, or caregivers used with infants plays an important role in the way children learn languages (Dunn, & Kendrick, 1982; Jacobson, Boersma, Fields, & Olson, 1983). Based on the latter studies, the way adults communicate with children can be classified into two main categories: *Adult Directed Speech* (ADS), which is defined as the usual way adults talk to each other, and *Infant Directed speech* (IDS) also known as *motherese*, which is the way adults modify the acoustic features of their speech by lowering their tempo, increasing their overall pitch and variability in pitch, adding redundancy to their speech, and using amplified vowels when talking and interacting with infants (Englund & Behne, 2006; Grieser & Kuhl, 1988; Kuhl et al., 1997).

Further research on IDS reveals that mothers, as well as fathers, grandparents, siblings, or even other adults with no experience interacting with infants, use IDS (Dunn, & Kendrick, 1982; Fernald et al., 1989; Jacobson, Boersma, Fields, & Olson, 1983; Shute & Wheldall, 2001; Weppelman, Bostow, Schiffer, Elbert-Perez, & Newman, 2003). Yet, most studies focused on maternal use of IDS even though it has been reported that parental or other non-parental adults' interaction can influence how infants acquire language (Kuhl, 2004). In an attempt to bridge this gap in the IDS literature, the current study seeks to investigate differences in maternal and

paternal use of IDS and aims to determine whether a relationship exists between infant attention and the use of IDS by analyzing the acoustic components of IDS, the functions of IDS, infants' preference of IDS, the differences between maternal and paternal IDS, and the influence of caregiving on IDS

Acoustical Components of IDS

IDS has many acoustical components that enhance infants' language acquisition process. As previously defined, IDS is characterized by lower tempo, higher and more variable fundamental frequency, exagerated vowels, simplify vocabulary and repetition (Fernald & Morikawa, 1993; Grieser & Kuhl, 1988; Kuhl et al., 1997). In this study we concentrated on three of them: slower tempo, over-articulated vowels, and higher fundamental frequency.

Slower tempo or slower speaking rate is a distinctive characteristic of IDS (Englund & Behne, 2006; Grieser & Kuhl,1988; Kuhl et al., 1997);. For instance, Fernald and Simon (1984) reported that German mothers spoke to their infants (2–5 days old) at a significantly slower speaking rate than when they spoke to other adults. Cooper and Aslin (1990) also reported that, on average, ADS utterances are 0.54 times shorter than IDS. Additionally, Fernald and colleagues (1989) showed that the pauses in ADS are significantly shorter than those of IDS are and that the average pause duration between utterances in IDS is significantly longer than in ADS. Thus, it seems that the slower tempo might allow infants more time to process the speech.

A second acoustical component of IDS is over-articulation of vowels; Vowels are more enunciated in IDS than in ADS (Gay, 1978). Research shows that the formant frequency (F1, F2) of infant directed vowels is significantly different from adult directed vowels (Kuhl, et. al, 1997). Formant frequency refers to acoustic resonance of the vocal track; the first formant frequency (f1) is the lowest resonance and the second one (f2) is the next-lowest resonance (Ladefoged,

1996); while resonance is the phonetic intensification and elongation of vocal tones during articulation. This was illustrated in Kuhl and colleagues' findings (1997), in which the authors chose 30 women with infants between 2-to-5 months for the experiment. Of this group, 10 were Americans, 10 were Russian, and 10 were Swedish. Each woman was tape recorded speaking IDS and ADS in two different sessions. The researcher used audio editing software to choose specific words for spectrographic analysis. A total of 2,363 words were chosen, resulting in 30,719 measurements (formant frequency, fundamental frequency, and vowel duration). Kuhl and colleagues found all the mothers over-exaggerated vowels in their words when interacting with infants. The range of formant frequency values was greater in all the languages. There was a significant rise in the fundamental frequency and vowel duration in all the languages. Fundamental frequency is lowest frequency starting from zero; it is accountable for the pitch we hear and it describes voices as "high-pitched", "low-pitched", or "monotonous voice" . The study shows that over-enunciated vowels are a part of IDS phonology.

Fundamental frequency, defined above, is a prominent characteristic of IDS. Research has indicated that an exaggerated range of pitch may be important to attracting and maintaining the attention of infants. For instance, Fernald and Kuhl (1987) isolated the three major acoustic correlates of intonation: fundamental frequency, amplitude, and duration. Infants showed a strong listening preference for the fundamental frequency of IDS over those of ADS; however, infants showed no preference for the signals derived from the amplitude. Based on these findings the authors suggest that the fundamental frequency characteristics of IDS may be the critical acoustic determinants of infant preference for *motherese*. These findings also suggest that the amplitude (which is the height between the peaks of a waveform and also determines volume) characteristics of IDS are not sufficient enough to elicit an infant preference for IDS. The

researchers also examined infant preference of duration and found that infants showed no preference for the signal's duration characteristics for either IDS or ADS. It is the fundamental frequency characteristics of *motherese* that accounts for infant preferences of IDS.

Functions of IDS

Given that IDS has been heavily researched, it is important to understand how the function of such speech influences infants' language development. Researchers have pinpointed three main functions of IDS (Colombo et al. 1995; Cooper et al., 1997; Grieser and Kuhl, 1988; Singh et al., 2002). The first function of IDS is to attract and maintain infants' attention. A second function is that IDS facilitates communication of positive affect and emotion between infants and caregivers. The third function of IDS is to facilitate language acquisition.

According to Fernald and colleagues (1989), these functions of IDS can co-occur during the first year of infant development, with the attentional and emotional phases being more prevalent during early infancy and the linguistic function becoming more important as the infant becomes older. For instance, many studies have reported that infants of different age groups pay more attention to IDS compared to ADS (Colombo et al., 1995; Fernald, 1992a, 1992b; Fernald & Simon, 1984). Other studies indicate that in addition to the attentional function, IDS helps to communicate affective information between infants and parents (Fernald 1993; Katz, Cohon, & Moore, 1996). Spence and Moore (2003), for instance, reported that young infants show basic emotional understanding when IDS is used; infants display greater positive affect, such as smiling, when approving vocalizations are used. Likewise, they show more negative affect, such as frowning, when disapproving vocalizations are used (Fernald, 1993).

Furthermore, studies have demonstrated that IDS helps with language development by transmitting various linguistic cues to infants; IDS contains grammatical cues, necessary to the

structures of languages that makes language acquisition easier for infants (Brent & Cartwright, 1996; Redford, Davis, & Miikkulainen, 2004). For instance, infants rather listen to utterances that start and finish at the correct boundaries of a sentence than utterances that start in the middle of a phrase. All these studies confirmed Fernald's (1989) findings that IDS functions occur through specific stages during infant development, which provides a better understanding of how the acoustic characteristics of IDS can benefit language development.

Preference for IDS

From a very young age, infants show preferences for IDS compared to ADS (Cooper & Aslin, 1990; Decasper & Fifer 1980; Kaplan, Goldstein, Huckeby, & Cooper 1995; Fernald & Kuhl, 1987). Infants' preference to IDS is widely found across languages. In a study conducted with German, Italian, Japanese, French, British English, and American English-speaking parents, Fernald et al. (1989) showed that all parents usually use IDS and that infants, between 10 to 14 months of age showed greater preferences for IDS over ADS.

Furthermore, Cooper (1990) demonstrated that infants' preference of IDS is not only common in older infants. The author investigated whether newborns and 1-month-old infants favored IDS over ADS by assessing whether or not the infant would look at a checkerboard longer when he/she listened to IDS or ADS. Cooper reported that although newborns' eye movements were harder to observe than 1-month-olds, infants from both age groups looked longer at the checkerboard when listening to IDS. These findings suggest that infants of all age groups prefer IDS over ADS. (Fernald, 1991, 1992a, 1992b; Fernald & Simon, 1984; Fernald et al., 1989; Grieser & Kuhl, 1988; McLead, 1993).

Maternal Vs. Paternal IDS

Although IDS has been widely studied, most research focuses only on the maternal use of IDS; however, IDS is not only unique to mothers. Fathers also modify their speech when interacting with infants, although slight differences have been reported in the fundamental frequency of paternal and maternal IDS (McRoberts & Best, 1997; Shute & Whedall, 1999). Fernald and colleagues (1989) found that both parents increased the mean frequency that they used and shorten the utterances when talking to infants; however, mothers increased the fundamental frequency of their voice twice as much as fathers did. Fathers, on the other hand, increased their pause duration in IDS significantly more than mothers did. Paternal and maternal differences were also reported in the amount of parental vocalization during parental interaction with children. It was reported that mothers talk more to their infants while fathers engage in more physical and social interaction with their infants (Leaper, Anderson, & Sanders, 1998). Even though the difference between maternal and paternal use of IDS is slight, it is important to understand that the way mothers and fathers use of IDS is not identical and such differences might be related to rates of caregiving.

Influence of Parental Involvement

The involvement of parents significantly affects infant development. Research categorizes parental involvement into three main components: engagement, accessibility, and responsibility (Lamb, Pleck, Charnov, & Levine, 1985, 1987; Pleck, Lamb, & Levine, 1985). Engagement reflects the amount of actual interaction with the child during both playtime and caregiving. Accessibility involves availability to the child without directly interacting. Responsibility involves making sure that appropriate resources are available to maintain the health of the child.

Many studies show that infants who are raised in two-parent families with highly involved parents are better adjusted than those raised in single families (Lamb & Tannis-LeMonda, 2004; Pleck & Masciadreli,2004; Radin,1988). High paternal involvement positively influences infants' cognitive development (Radin, 1998; Yogman, Cooley, & Kindlon, 1988). Moreover, infants benefit from interacting with both parents; because maternal involvement differs from paternal involvement (Radin, 1998; Yogman, Cooley, & Kindlon, 1988). For example, studies indicate that fathers are more involved in social activities, such as play, than caregiving (Bailey, 1994; Lewis, Feiring, & Weintraub, 1981). This might be because of the cultural perception of women as natural caretakers (Latshaw, 2011; Radin, 1988; Worthman, 2010; Yogman, Cooley, & Kindlon, 1988). In one study, Bailey (2001) found evidence that as maternal employment increases, paternal caregiving also increases. Additionally, research suggests that when mothers are employed, the amount of time that fathers spend engaging with infants' increases from roughly one-fourth to one-third of the mothers' time (Lamb & Tamis-LeMonda, 2004). Moreover, fathers' accessibility was found to increase from one-third of the mothers' accessibility to two-thirds. This increase in engagement and accessibility might influence fathers' use of IDS.

Present Study

These differences in parental use of IDS and their involvement's rate with their infants drive us to investigate whether or not differences in maternal and paternal use of IDS influence infant attention. We hypothesized that 1) there will be a difference in father's amount of caregiving based on mothers' work status, 2) the acoustic properties of IDS will be influenced by the amount of parental involvement in caregiving activities such as feeding, diaper changes,

bathing, not necessarily by gender of the parent, and 3) infants will pay more attention to parents who use more exaggerated IDS.

Methods

Participants

Data for this study were collected as part of a past research project conducted during home visits with families with a 6-month-old infant. The participants were 31 infants (19 females, 12 males) whose mean age was 6.97 months. All participants were healthy, full-term infants, and were recruited via a hospital visit when they were born and via mailed invitations from Emory University. Infants with parental history of neurological disorders, language disorders, and multilingual background were excluded. Parent gave their informed consent (See Appendix A). This study was part of a bigger study in which a second visit was conducted to record event-related potentials, but for the purpose of this study we will focus only on the first part of the experiment.

Procedures

Three types of data were collected for the current study: Parental questionnaires, behavioral observations, and event-related potentials to speech. The current study only focused on the first two types of data because the event-related potentials to speech were not used for this part of the study.

Questionnaires. Data for the current study were collected during home visits with the participating families. Initially, parents had to complete a medical questionnaire. Then, parental accessibility and engagement level were measured using questionnaires from previous studies (Ward & Cooper, 1999, Appendix B). Each parent had to complete a set of parental involvement questionnaires in which they had to evaluate their level of availability and participation. The questionnaire evaluated the amount of time each parent spends with his/her infant on a daily

basis; the type of activities performed by either parent during the time they spent with the infant, such as vocal play, burping, physical play, bathing, consoling, reading, putting to sleep, diaper changing, rocking, and feeding; and how engaging parents were with their infant. Parental verbal engagement, which is the amount of vocalization parents do with their infant, was measured on an 8-point Likert scale, with "1" being no talking and "8" being talking all the time. To ensure reliability and validity, one of the parents was instructed to complete the forms while their spouse was completing another task. The self-report form was used for data analysis, while the form completed for the partner was used for reliability purposes.

Recordings. Parental interaction with the infant was video recorded. During the recording, one parent started the behavioral interaction while the other parent completed the parental involvement questionnaire and then they switched. The recordings were made using a DV camcorder situated behind the parents with a Sony lapel microphone attached to the video camera. ADS was collected prior to recording the parent's interactions with the infant. Parents had to read a book to the experimenter and answer questions related to their daily activity to assess their ADS level. The experimenter also assessed parent and infant familiarity with the book and the toys using a 5-point Likert scale with "1" being "never read" and "5" being "read daily" for the book; and "1" being not at all familiar to "5" being very familiar" for the toys During the book reading phase of the video recording, parents were instructed to read *Goodnight Moon* twice, once to the infant in the way they usually read to the infant, and then to the experimenter in the way they would read to an adult. Using the same exact words during the book reading is important because it helps to directly compare the same speech across participants; the book reading to the infant was used to establish a measure of IDS, whereas the book reading to the experimenter was used to establish a measure of ADS. During the natural

interaction phase, parents were instructed to play with their infant for three minutes. Parents were given a set of toys, twelve plastic beads that could be taken apart, a plastic car, a plastic hippopotamus, and a plastic tiger, and were asked to interact as they normally interact with their infant during playtime. This phase was design to elicit natural IDS

Data Coding

Video Coding. The videos were transferred from the video camera to DVDs using iMovie. The files from the DVD were later converted from DV format to QuickTime format using *AVS* video converter. This conversion was necessary because the software used to code the videos was compatible only with that type of format. Three independent coders were selected to code the videos of the interaction between infant and parents. Each coder separately used *JWatcher Software* to code the behavioral interactions. Only 27 of the participants' behaviors were coded because 4 infants were off frame and their interaction could not be seen by coders. The video coding was conducted in two segments. In the first part, coders coded for the infant's attention to his/her parent based on the following codes: 1) following object with gaze (g), looking at object with intent (l), mouthing object (m), reaching for intended object (r), smiling at intended object (s), touching intended object (t), and infant stopped engaging (e). The measures for looking and gazing were chosen because many studies used them to asses infant continuous attention (Corkum, & Moore, 1998; Brooks, & Meltzoff, 2002). Morales, Mundy, & Rojas (1998) , showed that most 6 month old infants have the ability to follow their parents' gaze when adults were looking at anobject within infants' line of vision . In the second part of the video coding, coders coded for the amount of time parents engaged with the infant based on the following coding scheme: presenting infant with toy (p), actively speaking to infant (d), and parent stopping engagement with infant (q). To stay consistent with previous studies, the first

minutes of the 3-minute video recording were dropped to eliminate parents' reactivity to the camera. Once all the videos were coded, reliability between coders was calculated using the reliability function in JWatcher; the result obtained was Cohen's Kappa coefficient (Table 1). The inter-rater agreement reliability for the video coding was not very highbased on Cohen's Kappa significance (M=0.04, SD=0.13)

Acoustic Coding. iMovie software was used to extract sound from the videos, and then Praat software was used to analyze the three-minute play interaction between parents and infant.. The sound coding was done by one person. As defined in previous studies, utterances are small unit of speech separated by boundaries that are characterized by pauses longer than 300 milliseconds (Cooper et al., 1997; Kitamura & Burnham, 2003). Ten utterances were randomly selected for analysis. For the purpose of this study, utterances with nonverbal sounds such as animal noises and laughter, noisy background sounds, and the infant's babbling were excluded from the analysis because they would interfere with the acoustic analysis of parents' speech.

Results

Most of the parents who participated in the current study had an education above high school (Figure 1). Sixty-eight percent of the infants had no siblings, 22% of them had one sibling, and 10% had two siblings. Most infants stayed home with their mothers; the total average number of hours of childcare was 17.27 per week (SD=18.58). The minimum amount of non-maternal childcare was zero hours, while the maximum was 47.5 hours. On average, mothers worked 22.65 hours a week (SD=19.10). Almost half (48%) of the mothers stay at home, 45 % worked outside of the home; and 7 % worked both at home and outside of home on a part-time basis (Figure 2). Fathers, on the other hand, worked twice as much as mothers; they worked 48.10 hours per week on average (SD=10.02). Sixty-eight percent of the fathers worked

outside of the home, 13% worked at home, and 19% of them worked both at home and outside of the home (Figure 3).

For the first hypothesis, which was to determine whether there is a difference in the amount of caregiving fathers provided when mothers are working, we used data collected from the parental involvement questionnaires. Parental involvement was measure on a five point Likert scale with "1" being mothers always does and "2" being father always does. Mothers' and fathers' responses were consistent for the majority of the items on the parental questionnaires. Mothers' self-rating for the number of hour spent with infants weekly was a slightly higher than the fathers 'rating of mothers (Table 2). Fathers rated themselves higher for bathing and putting infants to bed compared to mothers' ratings of fathers (Table 3). No differences were found in most of the measures for paternal involvement based on mothers' work standing (Table 3). Our data indicate no matter who does the ratings, mothers spent more weekend and weekday hours with infants and were more involved in caregiving activities than fathers (Table 4). In spite of mothers' employment status, they were still more involved in caregiving activities than fathers (Figure 4). There were a few exceptions. Mothers who stayed at home fed infants more often than those who were employed, fathers' self-ratings on who feed infants were higher than mothers, and mothers' ratings on who burps infants were higher than fathers (Figures 5-6). A positive correlation was found between the amount of hours mothers work outside of home and who feed the infant, $r_s = 0.52$, $p = 0.02$; fathers were more likely to feed infants the more hours mothers work outside of home.

For the second hypothesis, we investigated the relationship between parental involvement in caregiving and the acoustic variables of ADS and IDS. A composite variable was created for parental involvement to measure caregiving using the mean of the ratings given for diapering,

feeding, bathing, burping, and putting infants to bed. This composite variable was called caregiving score and used along with the individual scores to investigate the second hypothesis. No relationship was established between the composite caregiving scores and the mean fundamental frequency, r=-0.16, p=0.20; there was, however, a slight correlation between the amount of parental involvement in burping for fathers and the number of utterances that fathers spoke $r_s = 0.32$, p = 0.04 (Table 5). There was no correlation between the mean fundamental frequency of IDS (rs= -0.20, *ns*, p= 0.47) and the amount of time fathers spent with their infant. There was no correlation between the mean fundamental frequency and most of the individual measures of caregiving for mothers; there was however a negative correlation between mean fundamental frequency and bathing and diapering (Table 6-7). Although there were many variations in the acoustic measures of parental speech, a consistent relationship was not found overall between measures of paternal involvement and the acoustic measures of parents' speech.

For the third hypothesis, the video recorded interactions were used along with the acoustic measures to assess the relationship between parents' use of IDS and infant's attention. A composite variable was created using the individual measures of infants' attention: gazing, looking, mouthing object, reaching, smiling, and touching intended object. This composite variable was referred to as infant attention scores; we also created a composite score for parental engagement using parents' individual measures of engagements: presenting infant with toy, actively speaking to infant. No correlation was found between mean fundamental frequency of IDS and infant attention for mothers (r=0.006, *ns*, p = 0.49) and fathers (r=-0.148, *ns*, p = 0.23).

Discussion

The current study investigated differences in maternal and paternal use of IDS and aimed to determine whether a relationship exists between infant attention and the use of IDS by

analyzing the acoustic components of IDS, the functions of IDS, infants' attention to IDS, and the influence of caregiving on IDS

Our first hypothesis was not supported because no difference was found between paternal caregiving and mothers' employment status. However, this result was consistent to previous studies that reported no significant increase in fathers' involvement when mothers are employed (Ahmeduzzaman & Roopnarine, 1992; Bailey, 2001; Ninio & Rinott, 1988; Volling & Belsky, 1991; Yeung, Sandberg, Davis-Kean, & Hofferth, 2001). Even when mothers were employed they still performed more caregiving activities and spent more time with infants than fathers.

The second hypothesis, concerning how parental involvement influences IDS, was partially supported. No relationship was found between the caregiving score and the mean fundamental frequency; however, we did find slight relationships between the fathers' involvement and the amount of vocalization. There was a relationship between the amount of vocal interaction and the amount of time parents spent with infants on a weekly basis; we also found a relationship between the number of IDS utterances fathers produced during the play session and their involvement in burping the infants. These findings are consistent with many previous studies that reported a relationship between parents' engagement and vocalizations (Ahmeduzzaman & Roopnarine, 1992; Bailey, 2001; Ninio & Rinott, 1988; Volling & Belsky, 1991; Yeung, Sandberg, Davis-Kean, & Hofferth, 2001). One of the reasons that there was no correlation between caregiving scores and the acoustic measures might be because parents may make these changes in their speech regardless of their involvement in caregiving. Other studies have found similar results; for instance, Jacobson and colleagues (1989) reported that parents increased the acoustic measures of their speech when talking to infants regardless of whether or not they have experience using IDS with infants. For the behavioral interaction, no relationship

was found between mean fundamental frequencies for either parent and infant attention; however, strong correlations were found between infants' individual measures and parents' engagement scores. The third hypothesis was not supported, no correlation was found between the fundamental frequency of IDS and the infants' attention scores.

Although most of our results are concurrent with previous research, the current study has a few limitations. First, the variability in the data was decreased because mothers were the primary caregivers in the present study regardless of their work. As found in our analysis, mothers assume the majority of the caregiving roles whether or not they are employed; consequently, instead of fathers' involvement increasing, mothers' employment might in some cases decrease paternal involvement. Employed mothers take over the responsibilities when they get home, which interfers with and decreases paternal involvement (Pedersen, Suwalsky, Cain & Zaslow1987). Another limitation is that a five-point Likert scale was used, with 1 being "mother always does it," 3 being "equal involvement," and 5 being "father always does it."; a larger scale may have produced more variability in the data. Third, collecting the speech for the acoustic measures analysis during play sessions might have been problematic. According to Rebelsky & Hanks, (1971) most natural vocalization happens while parents conduct caregiving tasks. Last, the inter-rater agreement reliability for the video coding was not high. This might be because the coding was not done frame by frame but rather whenever infants' attentions were noticed

Future research can address these issues. First, fathers who are more involved in caretaking roles could be included. Prueet (1998) reported that fathers who assumed the role of primary caretakers were more apt to understand infants' signals and are more receptive than other fathers. Second, the scale used to rate parental involvement might not have been sensitive enough. Further research should be designed with a likert scale with a greater variety of answer

choices, which may help increase variation in paternal answers. Last, when coding videos with more than one coder in the future, researchers should use specific structures such as time and frame.

Future research could also include a more diverse sample. Given that most parents in the present study were highly educated, future research should extend their population characteristics to include participants from more diverse backgrounds. Additionally, the current study was conducted with infants between 6 to 8 months old only, but could include older children to see if the results will vary by age.

Conclusion

Many studies have examined the influences of acoustic measures of speech on infants' language acquisition. The findings in these studies showed that the exaggerated acoustic properties of IDS contribute to infants' language development. Although many caregivers, siblings, or other adults change the acoustic measures of their speech when interacting with infants, most of these past studies only focused on the influences of maternal speech on infants' language development. The aim of the current study was to fill this research gap by contributing data on how fathers' involvement and use of IDS influence infants' language acquisition. Based on the results obtained, there was no difference in fathers' involvement with infants based on mothers' employment status. No relationship was established between IDS and paternal involvement; nor was a relationship found between infants' attention and IDS. However, the current study provides better understanding of how parental engagement helps to maintain infants' attention, and the role of fathers' engagement in infants cognitive development

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Appendix A: Consent Form

EMORY UNIVERSITY, DEPARTMENT OF PSYCHOLOGY BRAIN AND COGNITIVE DEVELOPMENT LAB PARENTAL CONSENT FOR A CHILD TO ACT AS A RESEARCH SUBJECT TWO VISITS- ERP TESTING AND AT-HOME INTERACTION FORM

TITLE: ***Neurobehavioral Development in Normal, Language Impaired, & Deaf Children***

PRINCIPAL INVESTIGATOR: DEBRA L. MILLS, Ph.D., ASSOCIATE PROFESSOR, DEPARTMENT OF PSYCHOLOGY, EMORY UNIVERSITY

CO-INVESTIGATORS: HELEN NEVILLE, Ph.D., PROFESSOR, DEPARTMENT OF PSYCHOLOGY, UNIVERSITY OF OREGON.

NAME: _____ DATE: _____

INTRODUCTION:

Debra Mills, Ph.D., is conducting a research study to find out more about how the brain works. We are particularly interested in how the brain might be organized in a special way for children who get a late start in talking, or have a family history (parent or sibling) of language problems or depression. Approximately 280 participants will be enrolled in the study over a 5 year period.

Your child has been asked to participate:

A. because he/she is a normal volunteer

or

B. because he/she has a small vocabulary for his/her age or has a parent or sibling who has been diagnosed with language problems.

or

C. because his/her mother was depressed (or treated for depression) during pregnancy or postpartum

If you agree for your child to be in this study, the following will take place over a 1 hour period with an additional home visit of approximately an hour. If you and your child enjoy these activities, we may ask you to participate in other studies, or to come back when your child is a little older.

PROCEDURES:

a) Your child's brain waves will be recorded by: An appropriately fitting cap with small metal disks (electrodes) sewn into it will be placed on your child's scalp and will be removed after the experiment. A small amount of electro-gel will be applied at each small metal disk position.

b) Your child will sit in a chair in a dimly lit room (pointed out to subject) and listen to auditory stimuli, including sentences in English or tones preceded by different amounts of silence, and/or see visual stimuli such as pictures of faces or objects.

c) Brain waves are to be recorded from your child's scalp while he/she pays attention to auditory and/or visual stimuli as described above. The brain waves will indicate how your child's brain operates when your child hears these stimuli.

d) Within a week of the ERP testing, an experimenter will visit you at home to record a mother-infant interaction and a father-infant interaction. These interactions will be of two types: the parent interaction with the infant using toys and the parent reading a book to the infant. This will allow us to measure how parents individually interact with their child.

This study has been explained to you and your child and we have answered your questions. If you have other questions or research-related problems, you may reach Dr. Mills at (404) 727-5030.

RISKS:
This study may involve the following discomforts to your child: (risks are negligible).

The procedures involved in his study will not place your child under any stress. The risks associated with this procedure are negligible. However, under rare circumstances, children with very sensitive skin may have a reaction to the application of the electro-gel. A small red mark may be apparent at one or more electrode locations. It has been our experience that this reaction is very rare, i.e., fewer than one in every hundred children. Additionally, the stickers used to secure the hat may leave a red mark when removed, much like a Band-Aid. Additionally, a little electrode gel will remain in your child's hair until it is washed.

BENEFITS:
Taking part in the research study may not benefit you or your child directly, however the information gathered may help the scientists learn more about neurobehavioral development.

CONFIDENTIALITY:
Research records will be kept confidential to the extent provided by law. Your name and other facts that might point to you will not appear when the data collected from this study is presented or published. These records will only be identified by number and are accessible only to Dr. Debra Mills and assistants.

COMPENSATION:
Your child will receive $6.00 per hour for his/her participation in the study, and select a toy of their choice from our laboratory worth approximately $5.00.

VOLUNTARY PARTICIPATION/WITHDRAWAL:
Participation in this research is entirely voluntary. You may refuse for your child to participate or withdraw at any time without jeopardy to the medical care she/he may receive at this institution.

CONTACT PERSONS:
For further questions concerning this research, contact Dr. Debra Mills at (404) 7275030. If you have any questions about your rights as a study participant, please contact James W. Keller, MD, Chair of the Emory University Institutional Review Board at (404) 712-0720.

ENTITLEMENT OF CONSENT FORM TO SUBJECT:
A copy of this consent form will be given to you.

Your signature below indicates that you consent to, or give consent for your child to be a volunteer for this study:

Participant's name	Date	Time
Parent or guardian signature	Date	Time
Signature of Witness	Date	Time
Signature of Person obtaining consent	Date	Time

Appendix B: Parental Involvement Questionnaires

PARENTAL QUESTIONNAIRE (FOR SELF)

Participant ID: _____

Filled out by: _____

1. Were you present at the birth of the child? Yes No

If not, how long have you been involved in caregiving for the child (in months)? _____

2. If the child is bottle fed, how many times do you feed him/her in a 24-hour period? (circle one)

1 2 3 4 5 (or more) times

3. Approximately how much time ***PER WEEK DAY*** (Monday through Friday) do you spend

0-30 min	6 hours
1 hour	7 hours
2 hours	8 hours
3 hours	9 hours
4 hours	10 hours
5 hours	> 10 hours

4. Approximately how much time ***PER WEEKEND DAY*** (Saturday-Sunday) do you spend with your infant? (please circle the appropriate number):

0-30 min	6 hours
1 hour	7 hours
2 hours	8 hours
3 hours	9 hours
4 hours	10 hours
5 hours	> 10 hours

1 2 3 4 5 6 7 8

8. Generally speaking, how much do you talk to your infant during your daily interactions? (please circle the appropriate number):

no talking	talk a littlebit	talk a fairamount	talk most of the time	talk all the time

5. We are interested in the typical activities that you engage in with your infant. Please rate the following activities:

1	2	3	4	5
Mom Always Does		Equal		Dad Always Does

vocal play _____ reading

burping _____ putting to sleep

physical play _____ diaper changing

bathing _____ rocking

consoling _____ feeding

6. Please add any additional comments here about ways that you may be involved with your infant and his/her well-being.

1 2 3 4 5 (or more) times

1. Approximately how much time ***PER WEEK DAY*** (Monday through Friday) does your partner spend with your infant? (please circle the appropriate number):

PARENTAL QUESTIONNAIRE (FOR PARTNER)

Participant ID:_____

Filled out by:_____

3. Was your partner present at the birth of the child? Yes No

If not, how long has your partner been involved in caregiving for the child (in months)?

4. If the child is bottle-fed, how many times does your partner feed him/her in a 24-hour period? (circle one)

0-30 min	6 hours
1 hour	7 hours
2 hours	8 hours
3 hours	9 hours
4 hours	10 hours
5 hours	> 10 hours

2. Approximately how much time ***PER WEEKEND DAY*** (Saturday-Sunday) does your partner spend with your infant? (please circle the appropriate number):

0-30 min	6 hours
1 hour	7 hours
2 hours	8 hours
3 hours	9 hours
4 hours	10 hours
5 hours	> 10 hours

5. Generally speaking, how much does your partner talk to your infant during his/her daily interactions? (please circle the appropriate number):

0	1	2	3	4	5	6	7	8
no talking		talk a little bit		talk a fair amount		talk most of the time		talk all the time

6. Please add any additional comments here about ways that your partner may be involved with your infant and his/her well-being.

Table 1

Reliability table

	Coder 1 – Coder2				Coder 1 – Coder2				Coder2- coder 3			
Participants	**MIInt Cohen's Kappa**	**FIInt Cohen's Kappa**	**MPInt Cohen's Kappa**	**DPInt Cohen's Kappa**	**MIInt Cohen's Kappa**	**FIInt Cohen's Kappa**	**MPInt Cohen's Kappa**	**DPInt Cohen's Kappa**	**MIInt Cohen's Kappa**	**FIInt Cohen's Kappa**	**MPInt Cohen's Kappa**	**DPInt Cohen's Kappa**
1	0.061	0.039	-0.273	0.071	-0.017	0.005	-0.001	0.067	-0.010	0.059	0.016	0.000
2	0.044	0.046	-0.017	0.019	0.017	0.072	0.005	0.041	0.050	0.004	0.112	0.064
3	-0.056	-0.056	-0.049	0.042	0.036	0.022	0.039	0.031	-0.033	-0.039	0.061	0.019
4	0.002	0.114	-0.107	-0.022	0.106	-0.038	0.056	0.010	0.029	0.022	0.005	-0.084
5	0.023	-0.033	0.048	0.030	-0.003	0.010	0.039	0.018	0.054	0.036	0.055	-0.041
6	0.054	0.011	-0.028	0.205	-0.062	-0.079	-0.038	0.262	1.000	0.091	-0.069	-0.162
7	-0.063	0.005	0.086	0.073	0.024	0.111	0.037	0.060	0.142	0.017	0.015	-0.043
8	0.081	0.010	-0.037	0.113	0.193	-0.024	-0.093	0.411	0.005	-0.003	0.155	0.049
9	0.029	-0.073	0.044	0.035	0.023	0.143	-0.189	-0.009	0.181	0.024	0.058	0.083
10	-0.014	0.035	0.181	0.056	0.019	0.062	0.276	-0.080	-0.017	0.284	-0.041	0.025
11	-0.048	-0.001	0.188	0.212	-0.052	-0.071	0.086	0.096	0.050	-0.117	0.151	0.128
12	0.002	0.063	-0.006	0.209	-0.035	-0.002	0.016	-0.105	-0.047	0.120	0.148	0.139

13	-0.020	0.077	0.214	0.077	0.032	0.131
14	-0.008	0.126	-0.055	0.064	-0.074	0.007
15	-0.133	0.021	0.098	0.113	-0.005	0.046
16	0.194	0.057	-0.143	0.056	0.129	0.013
17	0.025	0.040	0.116	0.022	0.043	0.016
18	0.006	-0.132	-0.090	0.247	0.146	-0.005
19	0.092	0.007	-0.080	0.056	0.003	0.046
20	0.004	0.060	-0.091	0.102	0.095	-0.001
21	-0.099	0.021	-0.058	-0.018	-0.097	-0.106
22	0.017	-0.024	-0.240	0.129	0.030	-0.053
23	-0.003	-0.029	-0.053	-0.119	0.026	0.057
24	0.086	0.038	0.085	-0.029	0.065	0.015
25	0.012	-0.113	0.052	0.085	0.040	-0.048
26	0.044	-0.045	0.083	0.133	0.013	0.048
27	0.013	0.010	-0.010	0.071	0.026	0.014
average	0.061	0.039	-0.273	0.071	-0.017	0.005

MIInt: Infants' attention to mothers

MPInt: Mothers' Interraction with infants

0.022	0.337	0.182	-0.032	0.209	0.054
0.264	-0.133	0.167	-0.054	0.015	0.150
-0.130	0.084	0.074	0.029	0.204	0.035
0.000	-0.082	0.134	0.006	0.270	0.098
-0.100	0.135	0.003	-0.058	-0.195	-0.010
0.176	0.090	-0.015	0.033	0.053	1.000
-0.058	0.029	0.102	-0.024	0.455	0.163
0.096	0.006	0.065	0.142	0.028	-0.043
0.003	0.014	0.065	-0.089	0.033	0.058
-0.158	-0.071	-0.102	-0.077	-0.033	0.174
0.279	0.008	0.052	0.064	-0.048	0.084
0.046	-0.050	0.084	-0.014	0.170	-0.013
0.189	0.288	-0.063	-0.002	0.041	0.060
1.000	-0.039	-0.023	0.008	-0.022	0.130
0.072	0.043	0.082	0.017	0.071	0.084
-0.001	0.067	-0.010	0.059	0.016	0.000

FIInt:Infants' attention to fathers

DPInt: Fathers' Interraction with infants

Inter-rater reliability in Kappa

Table 2

Analysis of Variance for Father's Self rating Based on Mothers' Work Status

	Mean(SD) Stay-at-home	Mean(SD) Work Outside of Home	F
Mother Weekly Work Hours	4.7(8.38)	39.21(6.56)	83.42**
Vocal Play	2.3571(0.93)	2.46(0.52)	0.65
Burping	2.07(0.83)	2.15(0.55)	0.32
Physical Play	2.79(0.97)	2.92(0.76)	0.11
Bathing	2.57(1.60)	2.38(1.19	0.17
Consoling	2.07(0.92)	2.38(0.65)	0.63
Reading	2.21(0.97)	2.62((0.87)	0.65
Putting to Sleep	2.79(1.42)	2.00(1.00)	1.91
Diapering	2.43(1.02)	2.69(0.85)	1.46
Rocking	2.14(0.86)	2.77(0.83)	2.17
Feeding	1.71(0.73)	2.31(0.48)	3.64*

**significant at $p < 0.01$ *significant at $p<0.05$

Table 3

Analysis of Variance for Mother's Self rating Based on Mothers' Work Status

	Mean(SD) Stay-at-home	Mean(SD) Work Outside of Home	F
Mother Weekly Work Hours	4.7(8.38)	39.21(6.56)	83.42**
Vocal Play	2.36(0.84)	2.31(0.63)	0.21
Burping	1.93(0.73)	2.77(1.01)	3.17*
Physical Play	2.57(0.94)	3.08(0.86)	1.62
Bathing	2.36(1.50)	2.00(1.00)	0.33
Consoling	1.93(0.83)	2.15(0.69)	0.64
Reading	2.14(0.95)	2.38(1.04)	0.26
Putting to Sleep	2.07(1.21)	2.08(0.76)	0.30
Diapering	2.36(0.84)	2.77(0.83)	0.83
Rocking	2.00(1.18)	2.54(0.97)	0.92
Feeding	1.79(0.70)	2.08(1.04)	0.39

**significant at $p < 0.01$ *significant at $p<0.05$

Table 4

	Mean(SD) Stay-at-home	Mean(SD) Work Outside of Home	F
Mother Weekly Work Hours	4.7(8.38)	39.21(6.56)	83.42**
Number of Father feeds infants	1.43(1.6)	1.38(1.12)	0.09
Number of Fathers' WEEK DAY hours	3.86(2.21)	3.08(1.19)	1.20
Number of Fathers' Weekend hours	8.57(2.17)	8.38(1.85	0.03
Number of Mother feed infants	3.79(2.08)	3.08(1.55)	0.83
Number of Mothers' WEEK DAY hours	9.29(2.67)	6.38(2.81))	4.95**
Number of Mothers' Weekend hours	8.86(3.01)	9.62(0.77)	0.52

Analysis of Variance for Parental Involvement Based on Mothers' Work Status

**significant at $p < 0.01$

Table 5

Correlation Matrix for Paternal Involvement measures and Mean fundamental Frequency

	Fathers' Mean F0	Mothers' Mean F0	Caregiving Score	Burping	Bathing	Putting to sleep	Diaper change	Feeding	# of time Father Feeds Infant
Fathers' Mean F0	-								
Mothers' Mean F0	-0.02	-							
Caregiving Score	-0.16	-0.34*	-						
Burping	0.09	-0.23	0.28	-					
Bathing	-0.16	-0.47**	0.79**	0.06	-				
Putting to sleep	-0.28	0.03	0.56**	0.25	0.37*	-			
Diaper change	0.13	-0.30	0.61**	0.19	0.45**	0.21	-		
Feeding	0.00	-0.30	0.40*	0.42*	0.24	0.14	0.31	-	
# of time Father Feeds Infant	-0.14	0.17	0.14	0.01	-0.11	-0.03	-0.11	0.20	-

*. Correlation is significant at the 0.05 level **. Correlation is significant at the 0.01 level
F0: Mean Fundamental Frequency.
IDS: Infant Directed Speech
ADS: Adult Directed Speech

Table 6

Correlation Matrix for Maternal Involvement measures and Mean fundamental Frequency

	Mothers' Mean F0	Fathers' Mean F0	Caregiving Score	Burping	Bathing	Putting to sleep	Diaper change	Feeding	# of time Father Feeds Infant
Mothers' Mean F0	-								
Fathers' Mean F0	-0.02	-							
Caregiving Score	-0.29	-0.13	-						
Burping	-0.22	0.19	0.73**	-					
Bathing	-0.53**	-0.02	0.63**	0.32*	-				
Putting to sleep	-0.05	-0.02	0.60**	0.48**	0.25	-			
Diaper change	-0.34*	-0.03	0.51**	0.59**	0.28	0.18	-		
Feeding	-0.16	0.45**	0.42*	0.58**	0.10	0.31	0.34*	-	
# of time Mother Feeds Infant	-0.08	0.01	-0.21	-0.30	0.11	0.01	-0.27	0.36*	-

*. Correlation is significant at the 0.05 level **. Correlation is significant at the 0.01 level
F0: Mean Fundamental Frequency.
IDS: Infant Directed Speech
ADS: Adult Directed Speech

Table 7

	Fathers' IDS Mean F0	Fathers' # IDS Utterances	Fathers' ADS Mean F0	Mothers IDS Mean F0	Mothers ADS Mean F0	Mothers' # IDS Utterances
Mothers' Caregiving Score	-	-0.15	-	-0.13	0.09	0.10
Fathers' caregiving score	-0.23	-	-0.06	-	-	-
Fathers' Relative Rating						
Burping	0.14	0.20	0.12	-	-	-
Bathing	-0.15	-0.28	0.09	-	-	-
Putting to Bed	-0.39*	-0.08	-0.16	-	-	-
Diapering	0.15	0.07	0.14	-	-	-
Feeding	0.11	-0.05	0.34*	-	-	-
Mothers' Relative rating						
Burping	-		-	-0.23	-0.16	0.07
Bathing	-		-	-0.43*	-0.004	0.12
Putting to Bed	-		-	-0.08	-0.24	-0.09
Diapering	-		-	-0.16	0.07	0.33*
Feeding	-		-	-0.04	0.18	0.29

*. Correlation is significant at the 0.05 level

Table 8

Infant Attention to parents

	Mean		SD		t		df	
	Mothers	Fathers	Mothers	Fathers	Mothers	Fathers	Mothers	Fathers
Gazing	37.79	37.25	188.4	188.5	1.061	1.046	27	27
Looking	45.43	45.57	186.92	186.92	1.286	1.29	27	27
Mothing	38.86	40.5	188.21	187.91	1.092	1.141	27	27
Reching	40.15	40.22	191.64	191.63	1.089	1.091	26	26
Smiling	38.22	37.59	192.02	192.14	1.034	1.017	26	26
Touching	42.3	43.41	191.23	191	1.149	1.181	26	26
PPresenting	41.74	42.33	191.32	191.22	1.134	1.15	26	26
PSpeaking	42.81	42.96	191.1	191.07	1.164	1.168	26	26

No significance differences between amount of attention infants pay to parents

Table 9

Correlation Matrix for Paternal Acoustic measures and infant attention

	Fathers' IDS Mean F0	Fathers IDS Utterances	Gazing	Looking	Mouthing	Reaching	Smiling	Touching
Fathers' IDS Mean F0	-	0.003	-0.151	-0.15	-0.15	-0.147	-0.148	-0.148
Fathers IDS Utterances		-	-.342*	-.341*	-.339*	-.343*	-.346*	-.348*
Gazing			-	1.000**	1.000**	1.000**	1.000**	1.000**
Looking				-	.999**	1.000**	1.000**	1.000**
Mouthing					-	1.000**	1.000**	1.000**
Reaching						-	1.000**	1.000**
Smiling							-	1.000**
Touching								-

*. Correlation is significant at the 0.05 level **. Correlation is significant at the 0.01 level
F0: Mean Fundamental Frequency.
IDS: Infant Directed Speech
ADS: Adult Directed Speech

Table 10

Correlation Matrix for Maternal Acoustic measures and infant attention

	Mothers' IDS Mean F0 Scores	Mothers' IDS Utterances	Gazing	Looking	Mouthing	Reaching	Smiling	Touching
Mothers' IDS Mean F0 Scores	-	-0.186	0.002	0.003	-0.005	0.007	0.011	0.005
Mothers' IDS Utterances		-	0.073	0.077	0.079	0.074	0.071	0.077
Gazing			-	1.000**	1.000**	1.000**	1.000**	1.000**
Looking				-	.999**	1.000**	1.000**	1.000**
Mouthing					-	1.000**	1.000**	1.000**
Reaching						-	1.000**	1.000**
Smiling							-	1.000**
Touching								-

*. Correlation is significant at the 0.05 level **. Correlation is significant at the 0.01 level
F0: Mean Fundamental Frequency.
IDS: Infant Directed Speech
ADS: Adult Directed Speech

Figures

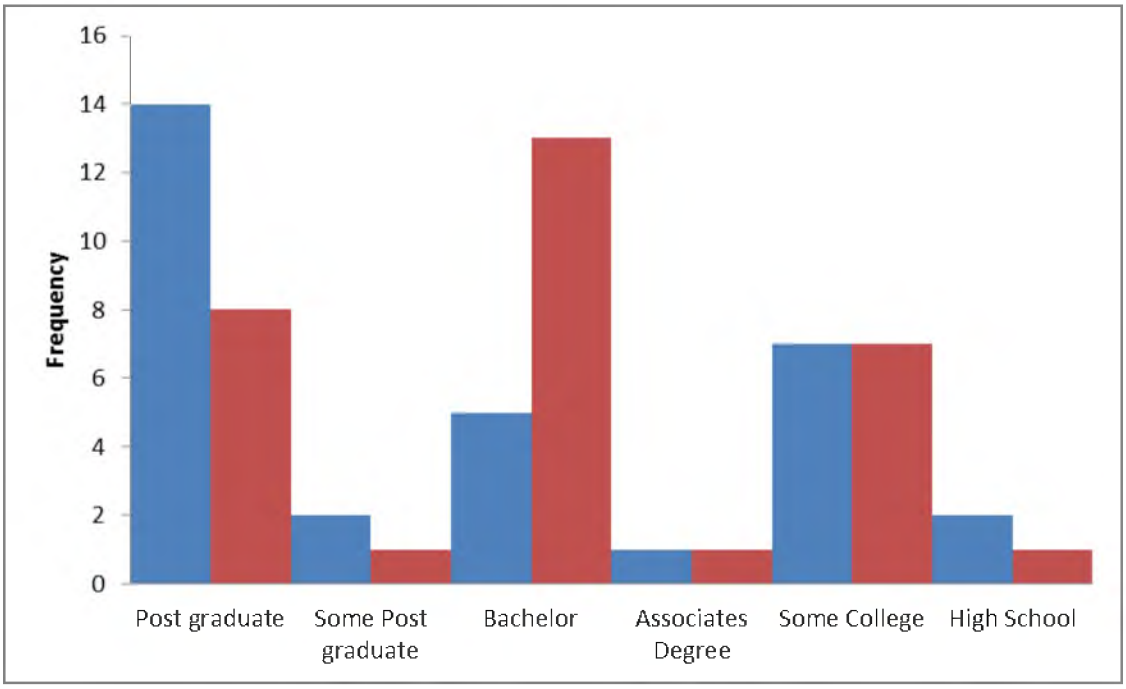

Figure 1. Parents' Education Level

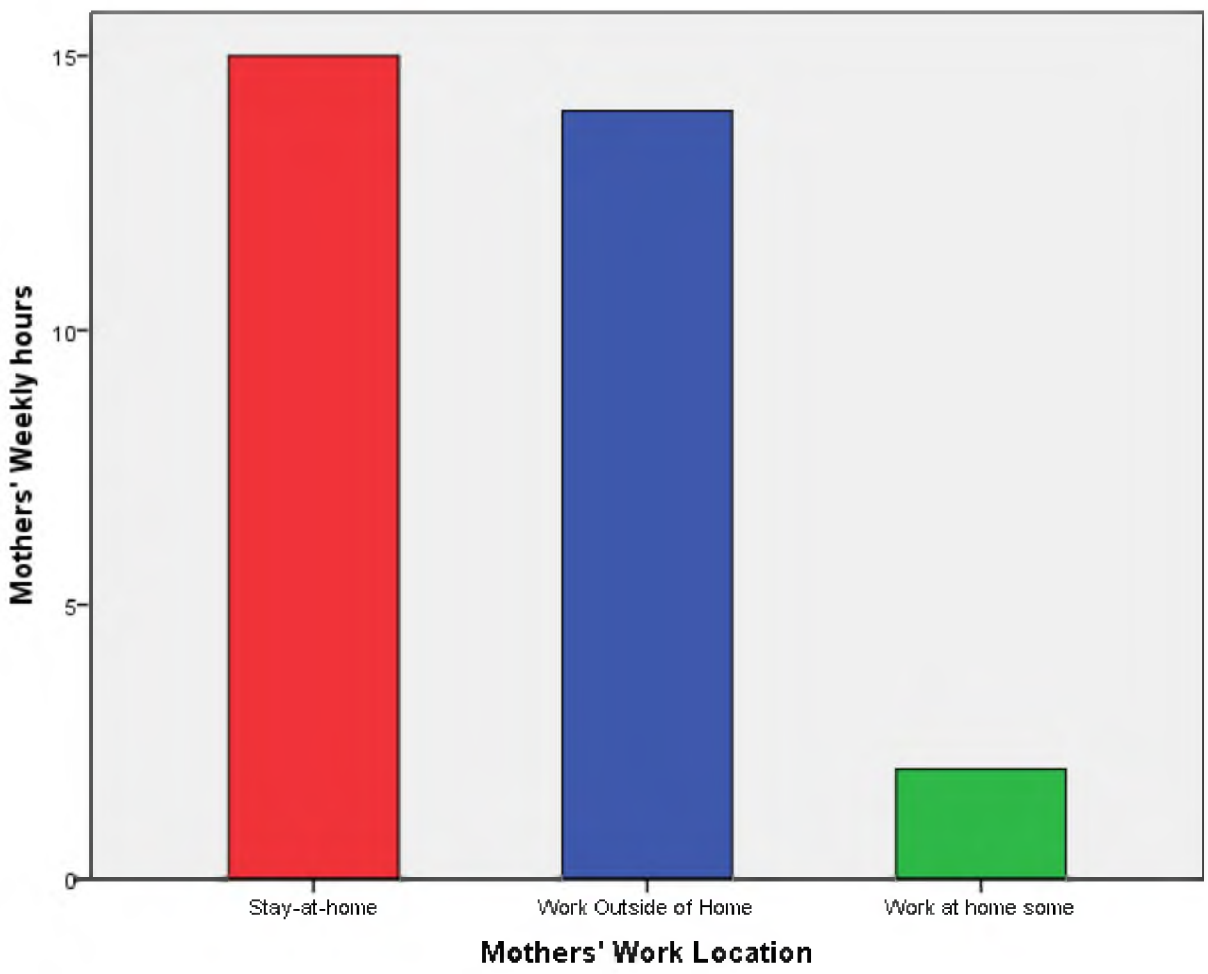

Figure 2. Time Spent with Infants. Estimated weekly time mothers spend with infants based on work location.

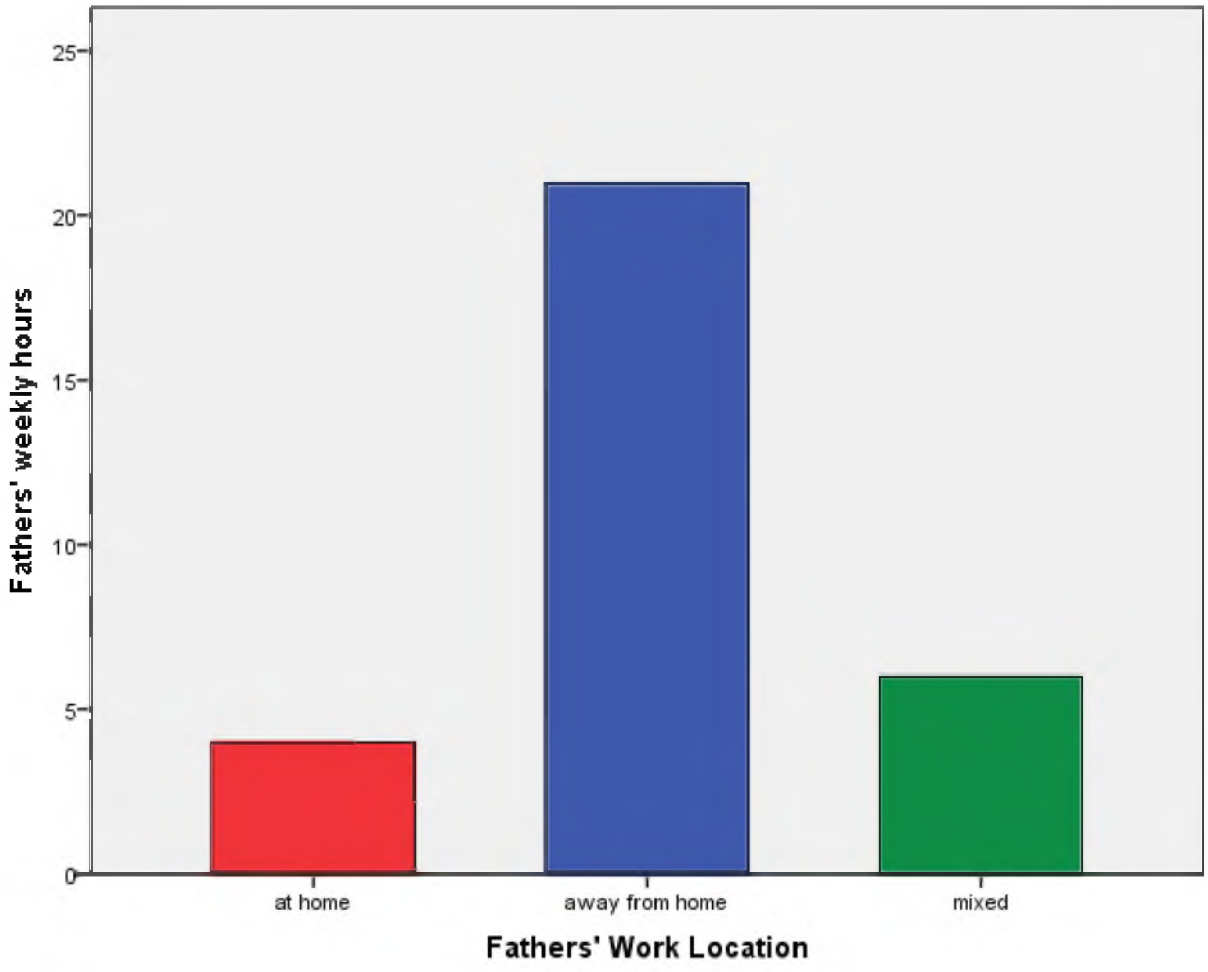

Figure 3. Time Spent with Infants. Estimated weekly time fathers spend with infants based on work location.

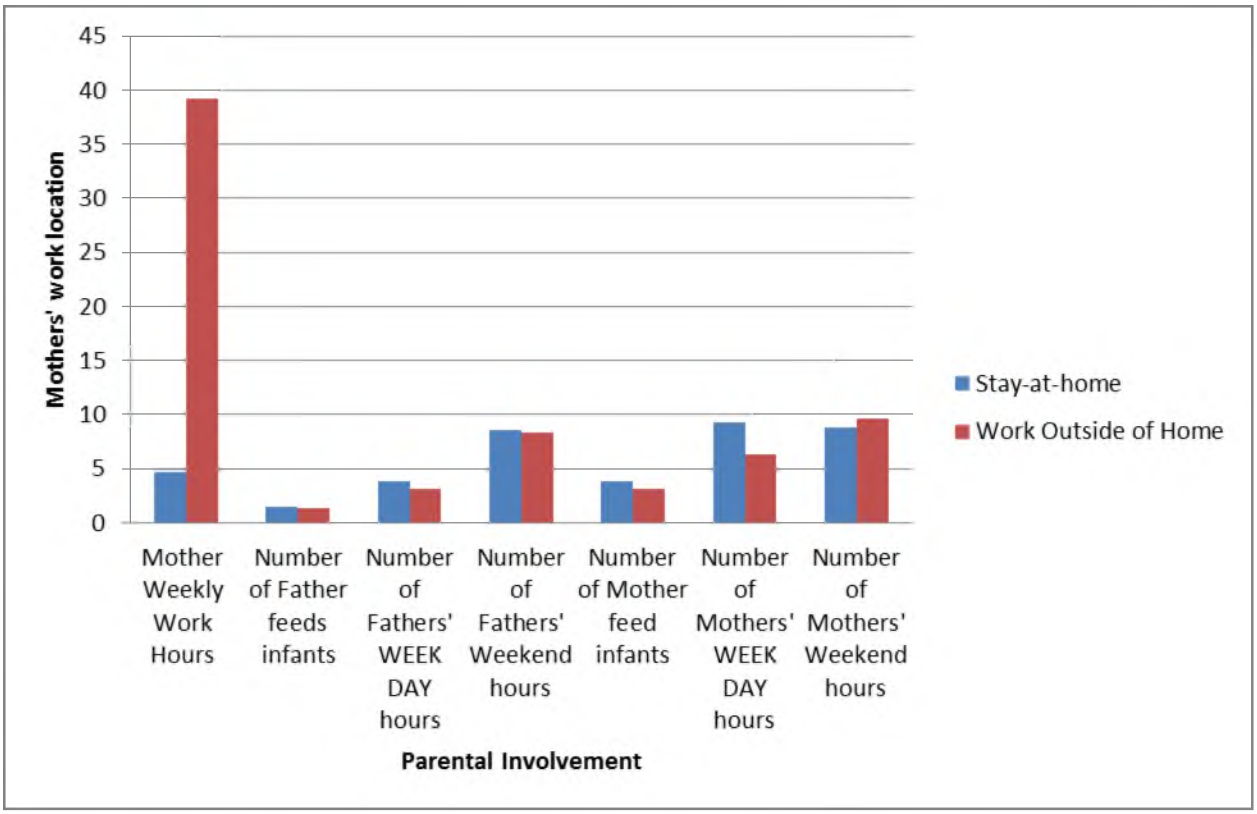

*Figure 4.*Parental Involvement Based on Mother Work Status

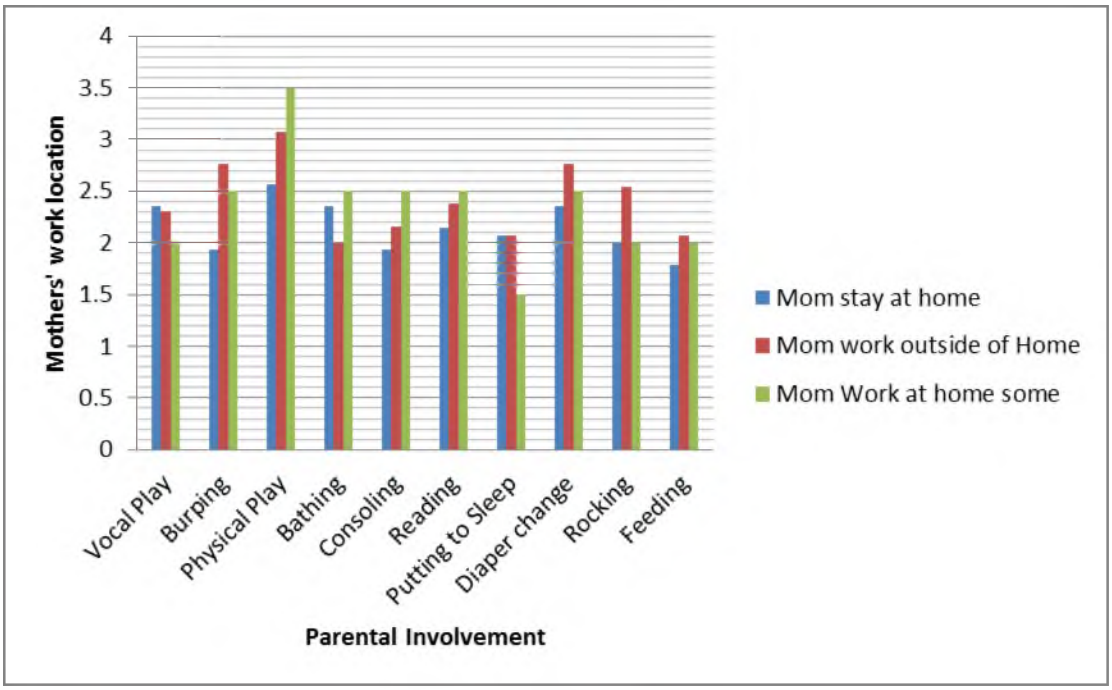

Figure 5. Mothers' self-Rating of caregiving

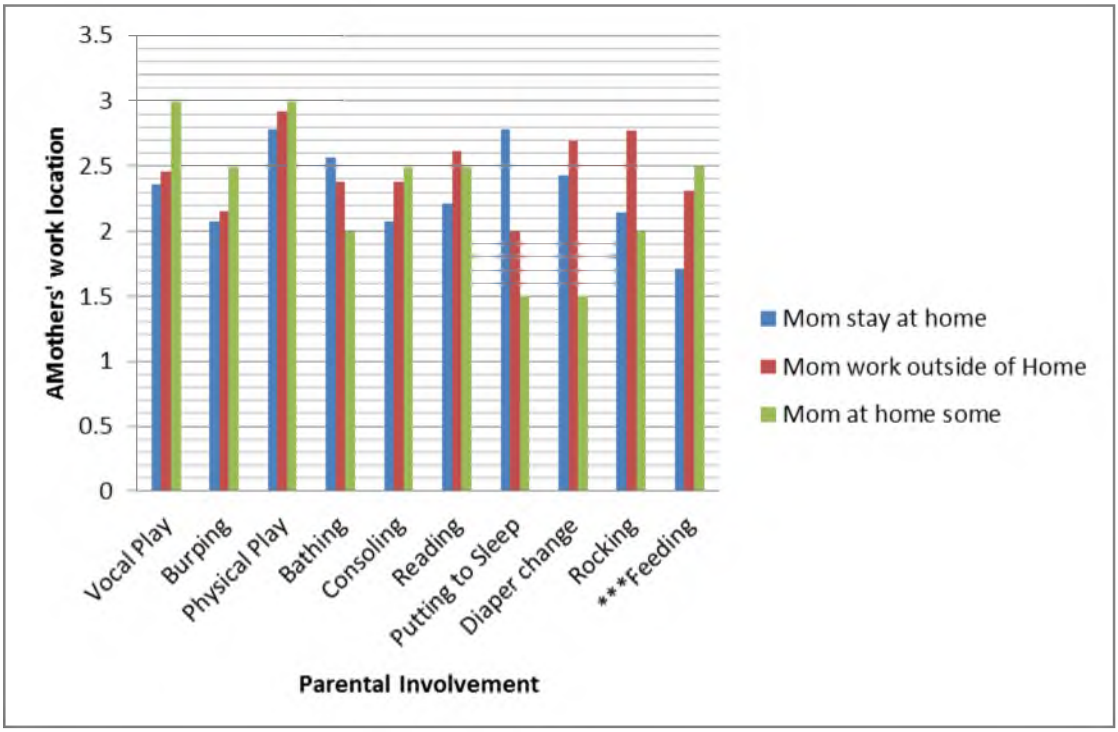

Figure 6. Fathers' self-rating of caregiving