CAN ANALYZING INFANT IMITATION IN THE NATURAL ENVIRONMENT INFORM INTERVENTIONS IN AUTISM?

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A longitudinal study of infants and their mothers was conducted to explore the development of imitation and approximations to imitation. During a 10-minute unstructured play session, researchers observed two mother-infant dyads once per week for twelve weeks, while they played at home. The data presented represents infants between the ages 5 and 34 weeks. The methodology employed was based on the methods described by Hart and Rilsey (1999). Observations were coded based on the topography of the mother's and infant's behavior and included vocalizations, facial movements, motor movements, and object manipulation. The data are analyzed and discussed in terms of its relevance to autism intervention.

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INTRODUCTION

Imitation has been a widely studied topic in the field of psychology. Many researchers define it as “any response, molecular or molar, which resembles previously observed behavior and occurs as a result of that prior observation” (Parton, 1976; Baer & Sherman, 1964; Flanders, 1968; Gewirtz & Stingle, 1968).

Imitation is considered a fundamental component of social, language, and cognitive development (Rogers and Pennington, 1991). Bandura (1965) theorized that imitation, even delayed imitation, is the basis for observational learning. It is through imitation that children learn socio-dramatic play and a variety of other play and social skills. Additionally, parental reinforcement of imitative approximations can shape infant and child behavior and aid in language development.

Imitation and Autism

The diagnostic criteria for an autism diagnosis includes a significant delay in language, impaired social skills, and restricted or repetitive interests (American Psychological Association, 2000). Each of these may be due, at least in part, due to a lack of imitative behavior in children with autism. Dequinzio et al. (2007) suggested a deficit in imitation may contribute to a deficit in the use of and the ability to discriminate non-vocal forms of communication like facial expressions and body language. Rogers and Pennington (1991) proposed motor imitation may be a *primary* deficit in children with autism, affecting development of social behaviors such as play interactions. It has also been suggested that difficulties with attention may prevent the development of imitation and other skills (Osterling & Dawson, 1994; Klin & Jones, 2008). It has also

been postulated that a deficit in social motivation contributes to a deficit in imitation skills in children with autism (Ingersoll et al., 2003; Trevarthen & Aitken, 2001).

The development of imitation skills is a key component in programming for autism treatment (Dawson, 2008). The level of social engagement, including imitation, prior to intervention has been cited as a predictor of response to intervention (Dawson, 2008). Imitation is not only a key component for learning in the natural environment, it is also vital to reciprocal and appropriate affective responding (DeQuinzio et al., 2007). Leaf & McEachin (1999) considered imitation the foundation upon which social, language, play, and self-help skills are built. In autism treatment, imitation training is referred to as a "learn-to-learn" program (Lovaas et al., 1981; Taylor & McDonough, 1996; Leaf & McEachin, 1999) It has been taught as a pre-requisite to teaching language (Harris, 1975; Rogers et al., 2006) social skills, (Heimann et al., 2006) and play skills (Ingersoll & Schreibman, 2006). Rosales-Ruiz and Baer (1997) defined a change in behavior as a "cusp" if it "exposes the individual's repertoire to new environments, especially new reinforcers and punishers, new contingencies, new responses, new stimulus controls, and new communities of maintaining or destructive contingencies." Teaching a child with autism to imitate can facilitate new and different social contingencies, which may in turn aid in further development. Thus, imitation may function as a "behavioral cusp."

Approaches to Teaching Imitation

Several forms of behaviorally based teaching methods have been employed in teaching imitation skills to children with autism. Some curricula use physical prompting to teach imitation skills (Taylor & McDonough, 1996; Leaf & McEachin, 1999, 153-157).

The teaching method known as discrete trial training (DTT) uses shaping, prompting, and prompt fading to teach modeled behavior. Baer et al. (1967) demonstrated the effectiveness of DTT in increasing the rate of imitation in three children with mental retardation. Baer and colleagues used shaping to establish imitation and eventually only reinforced behaviors that matched the model very closely. They used food reinforcers throughout the teaching sessions. The results of the study also showed an increase in the rate of novel imitations.

Ingersoll and Schreibman (2006) used a naturalistic teaching strategy known as reciprocal imitation training (RIT) to increase object imitation in five children with autism. In RIT, imitation is taught through five phases of modeling which progressively incorporated the use of objects and novel actions and stimuli. The children were initially not required to imitate; however, the therapist provided contingent praise and continued access to toys with spontaneous child imitation. If the child had not imitated after three opportunities, the therapist physically prompted the imitation and provided vocal praise. This form of teaching resulted in an increase in the rate of imitation for all five children and these rates remained stable after a one month follow-up for four of the five children. An increase in play, language, and joint attention was noted as a result of the RIT. Ingersoll, Lewis, and Kroman (2007) used the same teaching method to increase imitation of descriptive gestures. These increases also generalized to novel settings and maintained across time.

DeQunizio and colleagues (2007) used modeling, prompting, differential reinforcement and error correction to teach facial imitation to three children with autism. They used a token reinforcement system in which the children exchanged tokens for

snacks. All three children imitated facial movements more frequently at the end of treatment; but, only two of them generalized this skill across stimuli (DeQuinzio et al., 2007).

In 2008, Ganz and colleagues published the results of a study that used verbal and physical prompting to increase imitation rates in three children with autism. During the treatment phase, the children took turns being the leader. All the children were given toys and told to do what the leader was doing. If they did not imitate the leader, the teacher verbally and physically prompted following the leader. Vocal praise was delivered upon independent imitation.

In addition to intervention research, other studies have explained functions as well as topographies. Baer and Sherman (1964) found that reinforcement of some imitative responses functioned to maintain an entire class of imitative behaviors. Previously extinguished responses were maintained through reinforcement of other imitative responses. This experiment demonstrated that imitation is a functional response class. Peterson (1968) defines a functional response class as one that includes a variety of topographically different responses that share common controlling stimuli. Peterson (1968) replicated these results in a series of experiments involving reinforcement and extinction of imitative responses. He demonstrated that non-reinforced imitative behaviors maintained along with reinforced imitative behaviors and thereby classified as members of the same functional response class. Later research conducted by Young et al. (1994) suggested that for children with autism, imitative functional response classes were defined by topography (vocal, motor, and object manipulation).

If imitative responses belong to functional response classes, it is likely they are motivated by common reinforcers. This suggests consideration of generalized conditioned reinforcers. Parton (1976) explains the possible role of conditioned reinforcement. Originally proposed by Miller and Dollard (1941), this theory claims that the behaviors of parents function as a conditioned reinforcer. When the infant matches the parent's behavior, this matching is reinforced and produces the occasion for future imitation. The theory posits parental behavior functions as a conditioned reinforcer. This theory is supported by research. For example, Poulson and Kymissis (1988) showed an increase in the rate of imitative responses in three typical infants when mothers praised topographically similar responses.

Imitation in Typically Developing Infants

In developing teaching methods, behavior analysts sometimes look at literature representing the development of typically developing children to determine the type, scope, sequence and level of a skill to teach (McGee et al., 1977; Dyer & Peck, 1987). Data representing the age and sequence of developing imitation skills in typically developing infants may be useful in the study of autism treatment as well as in early diagnosis.

Researchers have investigated several aspects of imitation; how it develops as well as the variables that maintain it. Research has shown the ability of neonatal infants as young as two days old to imitate adult facial movements (Anisfeld, 1996; Meltzoff & Moore, 1983; Reissland, 1988; Vinter, 1986). These researchers have observed infants imitating tongue protrusion and mouth opening. Jacobson (1979) observed infants at 6, 10, and 14-weeks of age. She discovered that at six weeks of age, an adult moving a

pen and ball were as effective in eliciting a tongue protrusion as an adult modeling the tongue protrusion. At 14-weeks, an adult dangling a ring was as effective in eliciting a hand opening and closing as an adult modeling the hand movement. The present study was concerned with observing imitative interactions between typically developing infants and their caregivers. For that reason a review of observation techniques is included here in order to provide an overview of current approaches. The present study sought to build on these research methods.

Methods for Studying Parent-Child Interactions

The development of imitation skills has been studied in both clinical laboratory settings and in homes. Researchers have used both contrived interactions as well as naturalistic interactions. They have used a researcher as the model as well as the parents. Research has been conducted using longitudinal observations and experimental methods. Within the last ten years the number of longitudinal studies involving direct observation of parent-child dyads has increased. Because imitation develops throughout infancy, the methods of observing such young children is different than that for older children and adolescents. A comprehensive review of the literature involving direct observation of parent-child dyads was conducted. The articles presented in Table 1 were located using the search engine Psych Info and a combination of the descriptors “imitation,” “infancy,” “mother,” “direct observation,” and “dyad”. Articles that were selected met the following criterion: 1) all subjects were parent-child dyads 2) the experimenter was not physically part of the interaction 3) the children involved were at or below the age of 12 months at the start of the observation. It is clear from the review of past research that the observation of parent-child dyadic

interactions has been an invaluable source of information (Abravenel et al, 1976; Field et al., 1985; Flynn et al., 2004; Hart & Risley, 1992; Hsu & Fogel, 2001; Jones, 2007; Jonsson et al., 2001; Kokkinaki & Kugiumutzakis, 2000; Landry et al., 1998; Landry et al., 2001; Markova & Legerstee, 2006).

Eight of the studies reviewed observed parents and their child in an unstructured play session (Field et al., 1985; Flynn et al., 2004; Hart & Risley, 1992; Hsu & Fogel, 2001; Jonsson et al, 2001; Kokkinaki & Kugiumutzakis, 2000; Landry et al., 1998; Landry et al., 2001). No specific instructions were given on what to play with or how to play. One study observed contrived interactions in addition to the free operant play (Markova & Legerstee, 2006). Two others observed only contrived interactions (Abravenel et al., 1976; Jones, 2007). The form of data collection varied based on the behaviors being observed. One study used a 21-28 second interval (Abravenel et al., 1976). Three studies used 1-2 second intervals (Field et al, 1985; Hsu & Fogel, 2001; Markova & Legerstee, 2006) and three studies used 10-second intervals (Flynn et al., 2004; Jones, 2007; Kokkinaki & Kugiumutzakis, 2000). One study used a computer to record type, frequency, and duration of the behavior (Hart & Risley, 1992). Others counted instances and rated the interaction on a likert-type scale (Jonsson et al., 2001; Landry et al., 1998; Landry et al., 2001). Seven of the studies used video cameras to record interactions (Abravenel et al., 1976; Field et al., 1985; Flynn et al., 2004; Hsu & Fogel, 2001; Jones, 2007; Jonsson et al., 2001; Kokkinaki & Kugiumutzakis, 2000). The recording equipment varied from one camera to three remote controlled cameras. One study used only an audio tape recorder (Hart & Risley, 1992). Three studies either did not use cameras or did not describe the recording equipment in their methods (Landry

et al., 1998; Landry et al., 2001; Markova & Legerstee, 2006). Clearly, the number and quality of the recording devices are factors to consider when researchers are deciding on the setting of the observation. Five of the studies observed the parent-child dyad interactions in an infant laboratory (Abravenel et al., 1976; Field et al., 1985; Hsu & Fogel, 2001; Jones, 2007; Markova & Legerstee, 2006). Six of the studies observed the dyads in their homes. (Flynn et al., 2004; Hart & Risley, 1992; Jonsson et al., 2001; Kokkinaki & Kugiumutzakis, 2000; Landry et al., 1998; Landry et al., 2001). Of particular interest to the present study, Hart and Risley (1992) published the results of a 2½ year study of mother-infant dyads. This study had particular influence in the methodology utilized in the present research. Hart and Risley observed 42 dyads which included children 6 to nine months of age. They were observed for one hour each month. The observations were conducted in the home and were unstructured.

Information from these studies was used to design the present research including: the age of the children being observed, the number and frequency of observations, and the setting in which to observe. The purpose of the current study is to observe infant- parent interactions in a standardized format over the course of several weeks. Specifically, the goal was to identify classes of matching behavior across topographies (vocal, facial, motor, object manipulation).

METHOD

Participants

Two mother-child dyads are presented in the current study. Their pseudonyms are Abbott and his mother Samantha and Lucy and her mother Lola. Families were recruited through the use of flyers and word of mouth. The flyer used is in Appendix A.

The goal of the current study was to observe neurotypycally developing infants. Prior to the first observation, each child was administered the Rossetti Infant-Toddler Language Scale™ and the Hawaii Early Learning Profile® by a licensed speech and language pathologist. These assessments were administered again after the last play time session. Both children were considered typical, healthy, and neurologically intact and had no unusual medical history. The scores for each child are presented in Table 2.

Abbott and his mother Samantha were the first participants to enter the study. Abbott was 19 weeks old and Samantha was 26 years old at the start of their participation. Abbott, his mother, and father are all of Caucasian descent. Abbott, an only child, lived at home with his mother and father. Samantha was a homemaker and Abbott's father, who was 24 years old, worked in customer service. Their family income was less than $50,000 per year. Both parents had high school diplomas and during the time of participation, both parents were enrolled in undergraduate college courses. The family lived in a single family home with one pet dog.

Lucy and her mother Lola were the second participants to enter the study. Lucy was 5 weeks old and Lola was 31 years old at the start of this study. Lucy, her mother, and father are all of Caucasian descent. Lucy lived at home with her mother, father, two older brothers, and a pet dog. Lola was a homemaker who home schooled her two older

sons, ages 8 and 10. Lucy's father, who was 31 years old, worked as a licensed vocational nurse (LVN). Their family income was less than $50,000 per year. Both parents had high school diplomas. They lived in a single family home.

Settings & Materials

All sessions were conducted in the homes of the participants. The participants were told they could conduct the sessions wherever they felt most comfortable. No other instructions were given regarding the setting of the session or the presence of toys during the session. Sometimes toys were present, sometimes not.

Abbott and Samantha lived in a single level brick home. They completed all of their sessions in the living room, Abbott's bedroom, or occasionally both. The living room was a moderately sized room with tile floors and a large area rug. There were two couches and an entertainment center with a television and other electronic equipment. Abbott's bedroom was carpeted and contained a crib, changing table, rocking chair, dresser, and toys. The number and types of items present each session varied, but typically included a blanket, toys, bouncy seat, and pacifier

Lucy and Lola also lived in a single level brick home. All of their sessions were completed in the living room. The living room was a small room with hard wood floors and a large red area rug. There was a large couch, recliner, small chair, and entertainment center with a television and books. The number and types of toys present were similar to those of Abbott.

All sessions were recorded using a 60-minute Flip Video™ Camcorder. Other recording material included writeable DVDs, lap top computers, DVD players, pencils, red erasable pens, and data sheets. The writeable DVDs were used as media storage

for the play time sessions. Data collectors watched each session on a lap top computer or DVD player. They scored the occurrence of each behavior on the data sheet with pencils or pens with red erasable ink. The data sheet used is in Appendix B.

Procedures

The researchers met with each family in their home prior to any assessment or observation. During the initial meeting, the researchers explained the research goal and obtained informed consent (Appendix C). The researchers asked the parents questions regarding the names and ages of other children in the home, allergies of children or other family members, and the most convenient time for the observation sessions to occur. The Parent Interview is presented in Appendix D. The families were given a list of guidelines the researcher was required to follow during the observation. Researchers referred to the observation period as “play time session.” This information was given to the parents to explain the reasons the researcher would not be asking to hold their child or speaking to them during the play time session. The researchers did not hold, play with, or interact with the infants until after the final play time session was completed. The instructions given to parents are provided in Appendix E. Participation in the current study was voluntary and no monetary compensation given; however, each family was given a copy of all their recorded play time session.

Following the initial assessment, the first play time session was scheduled. The researcher followed the protocol provided in Appendix F. The day before the scheduled session, the researchers called the parents to confirm the day and time. Prior to the start of the session, the researcher gave the following instructions to the parents: ““Play with your child as you normally would. I will state when I am going to begin taping and

when I am finished taping. I will not speak to you during the 10 minutes that I am videotaping you and your child." The observer videotaped a play time log for 2-5 seconds. The play time log is a document containing the parent and child's pseudonyms, name of the observer, date and time of the session, and the session number. It is provided in Appendix G. There was also a place for the observer to write notes on information the parents may give about the mood and health of the child. Following the recording of the play time log, the parent and child were recorded for ten minutes. Following the completion of the session, the observer thanked the mother and confirmed the day and time for the next scheduled session.

Sessions were only interrupted if the parent requested due to child needs or if the recording equipment malfunctioned. The goal was to complete one play time session each week for twelve consecutive weeks. Due to illness and vacation, Abbott and Samantha took 15 weeks and Lucy and Lola took 14 weeks to complete their sessions.

After all play time sessions had been completed the researchers gave the families a copy of all of the video clips on DVD. At that time the mothers completed a post-participation questionnaire. The questionnaire is provided in Appendix H and the mother's responses to the satisfaction portion are presented in Appendix I.

Measures

Parent and child behaviors were observed and measured. The measures of parent and child behavior are outlined in Table 3. The complete observation code is provided in Appendix J.

Behaviors were defined by specific response topographies. Definitions were adapted from previous research. The measured behaviors include: adult directed talk,

child directed talk (Apel & Masterson, 2001; Butler et al., 2003), singing, babbling (MacNeilage et al., 2000), single sound, singing, mouth movement, eye movements, head movements, tongue movements, smiling (DeQuinzio et al., 2007), arm movements, touching object, banging object, slapping object, shaking object, squeezing object, and rubbing object. Each of these behaviors was grouped into classes based on their topography. The classes included vocalizations, facial movements, motor movements, and object manipulation (Bourgeois et al., 2005). The occurrence of each behavior was recorded in one-second intervals. During each second, there was the possibility of multiple behaviors to occur. These data were used to derive counts of the different forms of imitative matches. *Type* matches occurred when a parent behavior is followed with an infant behavior of the same form and the infant behavior occurs during the same interval or within the three seconds following the parent behavior. For example, if the mother smiled and then the child smiled, that would be scored as a type match. *Class* matches occurred when a parent behavior is followed with an infant behavior of the same class and the infant behavior occurs during the same interval or within the three seconds following the parent behavior. For example, if the mother banged a toy and the child rubbed the toy, that would be scored as a class match. *Out of Class* responses occurred when a parent behavior is followed with an infant behavior from a different class and the infant behavior occurs during the same interval or within the three seconds following the parent behavior. For example, if the mother clapped her hands and the child smiled, that would be scored as an Out of Class response. Descriptions of the derivation of the data are included in Table 4. The first column lists the form of the match. The second column gives a brief definition. The third column

indicates the recording interval. When scoring the derived data, the data collector looked at the infant behavior in the three seconds following each parent behavior to determine the presences of a match. The last column defines the conversions used. A segment of data is presented in Figure 1. In that segment of data, there are 11 Type matches, 7 Class matches, and 7 Out of Class responses.

Certain intervals were considered invalid. Reasons for marking an interval as invalid included parent or child out of view of the camera, parent or child interacting with another person or animal, and when the parent or child had their back to the dyad partner. Four of Abbott and Samantha's sessions were excluded from the data pool because the entire sessions were invalid. A detailed description of the rules for marking intervals as invalid is provided in Table 5. The primary data collector marked invalid intervals with a highlighter and those intervals were discounted from the data pool. The number of remaining valid intervals was divided by 60 in order to determine the total number of valid minutes. This calculation was completed for each form of match within each behavior class. Figures 1 and 2 represent the number of valid minutes in each session for Abbott and Lucy, respectively.

Data Collection

I and a fellow graduate student from the University of North Texas were the primary data collectors. Reliability data were collected by a graduate student from the University of North Texas. Each data collector was given a copy of the observation code and data sheets. The author trained the data collectors by watching segments of the play time sessions, discussing examples and non-examples, and practicing collecting data.

Data collectors watched and collected data for each behavior class separately for parent and child behaviors. The data collectors marked a line through each behavior for every second it occurred in the video. Definitions and examples for scoring data are presented in the observation code in Appendix J.

Interobserver Agreement

Interobserver agreement (IOA) was calculated for each behavior type for four ten-minute samples, two for each dyad. An IOA percentage was determined for each behavior type by dividing the number of agreements by the number of disagreements and then multiplying by 100 (Cooper et al., 1987/2007).

Data Analysis

The rate of matches per minute are graphically displayed in Figures 3-8. The *y*-axis displays rate per minute. The rate was determined by dividing the number of matches for each of the derived measures (Type match, Class match, and Out of Class response) by the number of valid minutes. This calculation was done for each behavior class. The *x*-axis for figures 3-8 represents the age of the child in weeks. The data for each child were first analyzed by graphing the derived measures for all behavior classes combined. Next, the total number of all matches was graphed by topography (vocalizations, facial movements, motor movements, and object manipulations). Finally, the data were analyzed in terms of match forms and topography.

RESULTS

The interobserver agreement (IOA) scores are presented in Table 6. The overall IOA was calculated separately for parent and child behaviors by taking the average IOA for four observation sessions (two for each child). The overall IOA for parent vocalizations was 94.29 (range 87.85 to 100). The overall IOA for parent facial movements 88.8 (range 63.02 to 97.22). The overall IOA for parent motor which only included arm movements was 69.16. The overall IOA for parent object manipulation was 94.48 (range 81.08 to 100). The overall IOA for child vocalizations was 95.33 (range 85.99 to 100). The overall IOA for child facial movements 75.69 (range 53.91 to 98.43). The overall IOA for child motor which only included arm movements was 75.68. The overall IOA for child object manipulation was 97.08 (range 89.25 to 100). The overall IOA for all child and parent behaviors combined was 90.18.

Figure 2 shows the number of valid intervals for Abbott and Samantha. There was an average of 8.6 valid minutes available for Type matches, Class matches, and Out of Class responses for Abbott's vocalizations, motor movements, and object manipulation (range 6.6 to 9.8). There was an average of 5.8 valid minutes available for Type and Class matches for Abbott's facial movements (range 2.5 to 7.9). There was an average of 7.6 valid minutes available for Abbott's Out of Class matches for facial movements (range 3.2 to 9.8).

Figure 3 shows the number of valid intervals for Lucy and Lola. There was an average of 9.8 valid minutes available for Type, Class, and Out of Class matches for Lucy's vocalizations, motor movements, and object manipulation (range 9.1 to 10). There was an average of 5.4 valid minutes available for Type and Class matches for

Lucy's facial movements (range 2.4 to 9.5). There was an average of 8.4 valid minutes available for Lucy's Out of Class responses for facial movements (range 5 to 9.7).

The derived data presented in Figures 4 through 6 shows the rate of behavior for Abbott across consecutive week of his life during the observation period.

Figure 4 shows the rate of Type matches, Class matches, and Out of Class responses. Abbott averaged 25.2 Type matches per minute throughout the eight valid sessions. His Type matches ranged from 9 to 45.6 per minute (range 36.7). Abbott averaged 28.8 Class matches per minute. His Class matches ranged from 5.7 to 53.5 per minute (range 47.8). Abbott averaged 57.5 Out of Class response per minute. His Out of Class responses ranged from 13.3 to 90.3 per minute (range 77).

Figure 5 shows the rate of all behavior matches combined for vocalizations, facial movements, motor movements, and object manipulations. The top panel in Figure 5 represents vocal matches. Abbott averaged 13.1 vocal matches per minute throughout the eight valid sessions. His rate of vocal matches ranged from 2.1 to 39.6 (range 37.5). The second panel in Figure 5 represents facial matches. Abbott averaged 62.8 facial matches per minute. His rate of facial matches ranged from 19.3 to 126.9 (range 107.6). The third panel in Figure 5 represents motor matches. Abbott averaged 11.4 motor matches per minute. His rate of motor matches ranged from zero to 31.5 (range 31.5). The last panel in Figure 5 represents matches for object manipulation. Abbott averaged 24.1 matches per minute for object manipulation. His rate of matches for object manipulation ranged from zero to 48.7 (range 48.7).

Figure 6 shows the rate per minute of the Type, Class, and Out of Class responses for vocalizations, facial movements, motor movement, and object

manipulation. The top panel in Figure 6 represents the data for vocalizations. Abbott averaged 2.7 vocal Type matches. His rate of vocal Type matches ranged from zero to 7.9 (range 7.9). Abbott averaged 5.3 vocal Class matches. His rate of vocal Class matches ranged from 0.7 to 16.3 (range 15.6). Abbott averaged 5.1 vocal Out of Class responses. His rate of vocal Out of Class responses ranged from 1.3 to 15.4 (range 14). The second panel in Figure 6 represents the data for facial movements. Abbott averaged 15.5 facial Type matches. His rate of facial Type matches ranged from 5.9 to 34.1 (range 28.1). Abbott averaged 20.7 facial Class matches. His rate of facial Class matches ranged from 2.6 to 45.2 (range 42.6). Abbott averaged 26.6 facial Out of Class responses. His rate of facial Out of Class responses ranged from 10.8 to 47.7 (range 36.9). The third panel in Figure 6 represents the data for motor movements. Abbott averaged 1.3 motor Type matches. His rate of motor Type matches ranged from zero to six (range 6). Because there was only one behavior counted in the Class of motor movement, it is not possible for a Class match to occur. Abbott averaged 10.1 motor Out of Class responses. His rate of motor Out of Class responses ranged from zero to 25.6 (range 25.6). The bottom panel in Figure 6 represents the data for object manipulation. Abbott averaged 5.7 Type matches for object manipulation. His rate of Type matches for object manipulation ranged from zero to 11.4 (range 11.4). Abbott averaged 2.8 Class matches for object manipulation. His rate of Class matches for object manipulation ranged from zero to 6.4 (range 6.4). Abbott averaged 15.6 Out of Class responses for object manipulation. His rate of Out of Class responses for object manipulation ranged from zero to 36.1 (range 36.1).

The derived data presented in Figures 7-9 shows the rate of behavior for Lucy across consecutive week of her life during the observation period.

Figure 7 shows the rate of Type matches, Class matches, and Out of Class responses. Lucy averaged 37.4 Type matches per minute throughout the 11 valid sessions. Her Type matches ranged from 16.9 to 71.2 per minute (range 54.2). Lucy averaged 53.3 Class matches per minute. Her Class matches ranged from 21.4 to 84.9 per minute (range 63.5). Lucy averaged 69.6 Out of Class responses per minute. Her Out of Class responses ranged from 31.6 to 104.4 per minute (range 72.8).

Figure 8 shows the rate of all behavior matches combined for vocalizations, facial movements, motor movements, and object manipulations. The top panel in Figure 8 represents vocal matches. Lucy averaged 12.1 vocal matches per minute throughout the 11 valid sessions. Her rate of vocal matches ranged from 3.8 to 21 (range 17.3). The second panel in Figure 8 represent facial matches. Lucy averaged 124.9 facial matches per minute. Her rate of facial matches ranged from 54.3 to 220.8 (range 166.5). The third panel in Figure 8 represents motor matches. Lucy averaged 15.3 motor matches per minute. Her rate of motor matches ranged from 6.1 to 30.9 (range 24.8). The last panel in Figure 8 represents matches for object manipulation. Lucy averaged 7.9 matches per minute for object manipulation. Her rate of matches for object manipulation ranged from zero to 31.6 (range 31.6).

Figure 8 shows the rate per minute of the Type, Class, and Out of Class responses for vocalizations, facial movements, motor movement, and object manipulation. The top panel in Figure 9 represents the data for vocalizations. Lucy averaged 2.4 vocal Type matches. Her rate of vocal Type matches ranged from 1.1 to

5.2 (range 4.0). Lucy averaged 4.6 vocal Class matches. Her rate of vocal Class matches ranged from 1.5 to 8.2 (range 6.7). Lucy averaged 5.1 vocal Out of Class responses. Her rate of vocal Out of Class responses ranged from .6 to 8.8 (range 8.2). The second panel in Figure 9 represents the data for facial movements. Lucy averaged 31.6 facial Type matches. Her rate of facial Type matches ranged from 14.7 to 65.4 (range 50.7). Lucy averaged 47.7 facial Class matches. Her rate of facial Class matches ranged from 19.7 to 78.6 (range 58.9). Lucy averaged 45.5 facial Out of Class responses. Her rate of facial Out of Class responses ranged from 19 to 80.5 (range 61.4). The third panel in Figure 9 represents the data for motor movements. Lucy averaged 0.6 motor Type matches. Her rate of motor Type matches ranged from zero to 3.1(range 3.1). Because there was only one behavior counted in the class of motor movement, it is not possible for a Class match to occur. Lucy averaged 14.7 motor Out of Class responses. Her rate of motor Out of Class responses ranged from 6.1 to 27.8 (range 21.7). The bottom panel in Figure 9 represents the data for object manipulation. Lucy averaged 2.8 Type matches for object manipulation. Her rate of Type matches for object manipulation ranged from zero to 13.4 (range 13.4). Lucy averaged 0.9 Class matches for object manipulation. Her rate of Class matches for object manipulation ranged from zero to 5.1 (range 5.1). Lucy averaged 4.2 Out of Class responses for object manipulation. Her rate of Out of Class responses for object manipulation ranged from zero to 15.4 (range 15.4).

DISCUSSION

The purpose of the current study was to observe typical infants and their mothers over the course of several weeks. The goal was to identify behaviors that occur prior to the development of imitation across topographies (vocal, facial, motor, object manipulation). The data presented shows infants as young as 5-37 weeks of age are able to match the behavior of a model with a behavior of the same type. Additionally, they match behaviors within the same class and out of class. The data representing Abbott and Lucy had several commonalities. Across all sessions the Out of Class responses occured at a higher rate per minute than any other type of match. While the rate of of Class matches and the rate of Type matches were close, the Class matches typically occurred at a slightly higher rate than the Type matches. Lucy showed a greater difference in the rate of Type and Class matches than did Abbott. For both children, the data paths of Type, Class, and Out of Class responses are similar. Also for both chidlren, the rate of Type, Class, and Out of Class responses for vocalizations were similar across all sessions. Both children had a higher rate of facial matches than vocal, motor, or object manipulation. Lucy, however had, on average, twice as many vocal matches than Abbott. This supports findings of past researchers in the area of infant imitation (Anisfeld, 1996; Jacobson, 1979; Meltzoff & Moore, 1983; Reissland, 1988; Vinter, 1986).

Implications for Infant Imitation and Autism Intervention

Rogers and Pennington (1991) postulated imitation as an essential component of social, language, and cognitive development. They also hypothesized that the imitation deficit in children with autism contributes to the deficits required for an autism diagnosis.

The results of the current study are in line with the results of past research. Both infants showed more matches for facial movements than any of the other topographies. This is consistent with the research showing very young infants are able to imitate facial movements (Anisfeld, 1996; Meltzoff & Moore, 1983; Reissland, 1988; Vinter, 1986). Abbott's higher rates of matches for vocalization, motor movements, and object manipulation may be due to his age. However, as a child ages and their physical capabilities increase, their exposure to reinforcement may increase through additional contact with toys, vocalizations, and physical movements of others.

The current research sought to observe differences in the types and rates of matches across four topography-defined behavior classes (vocal, facial, motor, object manipulation). The data paths of Type, Class, and Out of Class responses are similar for all four behavior classes. This was the case for both children. Also for both chidlren, the rates of Type, Class, and Out of Class responses for vocalizations and facial movements were similar across all sessions. Both children had a higher rate of facial matches than of vocal, motor, or object manipulation. The research conducted by Young et al. (1994) showed imitative response classes in children with autism are defined by topography. This research followed studies which defined imitation in neurotypically developing children as a response class (Baer and Sherman, 1964; Peterson, 1968).

If an increase in physical capabilities leads to the additional exposure to contingencies of reinforcers and punishers, that physical maturation can be conceptualized as a "behavioral cusp" (Rosales-Ruiz & Baer, 1997). If this is the case, it is not surprising Lucy had twice the rate of facial matches than Abbott and Abbott had a

greater rate of matches for vocalizations, motor movements, and object manipulation than Lucy. This information may guide behavior analysts in determining the sequence in which imitation should be taught. Additionally, increasing the reinforcement value of toys, may aid in the development of play imitation.

The procedures used in teaching children with autism to imitate have varied. Baer and colleagues (1967) reinforced behaviors which topographically matched the model. Additionally, using shaping as a procedure to teach imitation required the researchers to reinforce successive approximations to a type match. Other researchers have used physical prompting as a strategy to teach imitation (Ingersoll & Schreibman 2006; Ingersoll et al., 2007). DeQunizio and colleagues (2007) used a combination of modeling, prompting, differential reinforcement and error correction. Ganz and colleagues (2008) employed both verbal and physical prompting to teach imitation. Both curricula commonly used in autism treatment suggest the use of physical prompting (Taylor & McDonough, 1996; Leaf & McEachin, 1999, 153-157). The current study, however; shows infants match the behavior of a model with behaviors of the same topography (class match). This suggests it may be more beneficial to reinforce successive approximations to imitation, as Baer and colleagues (1967) did, than to physically prompt children to imitate.

Limitations

The data presented should be interpreted with caution due to factors not contolled in the current study. The number of usable intervals vaired across sessions due to an inconsistancy in the video taped sessions. The reasons for the inconsistancy include the following: the position of the child to the parent, the presence of toys, the

use of a pacifier, the angle of the camera. The position of the parent and the child affected the amount of time their faces were visable to the camera. Often times only one of their faces was visible to the camera. Additionally, the mother's hair and glasses commonly obstruced the view of the camera. The presence of toys was inconsistant for both mother-child dyads. Neither dyad used toys in their interaction every session. The presence of toys changes the interaction and gives the child something to attend to other than the mother's face and motor movements. Standardizing the presence of toys across all sessions may show the point at which the child begins attending to them more. The use of a pacifier was common throughout the sessions for both children. The pacifier blocked the view of the mouth and may have inhibited it's movement of the mouth. The angle of the camera was difficult to keep standard. If the parent and child moved around, the camera had to be moved and it was not always possible to keep both mother and child in view of the camera. All of these factors may have contributed to invalid intervals.

Many of these problems could be reduced through the use of an infant laboratory. Past researchers have utilized infant laboratories in their studies (Abravenel et al., 1976; Field et al., 1985; Hsu & Fogel, 2001; Jones, 2007; Markova & Legerstee, 2006). Field et al., (1985) described their infant laboraory as "living room" like. Hsu and Fogel (2001) described their laboratory as a "play room". The goal of the current research is to observe natural interactions of mother-infant dyads. If future researcher choose to utilize an infant laboraory, it should have a "home-feel" to it. That is, it should be designed to make the mother and infant feel like they can interact as freely as the would at home. The use of an infant laboratory would allow the standard presence of

toys. Whether the dyads choose to use them or not might not be standardized; however, the option to use them can. Often times, in the current study, the child watched the camera and looked at the researcher during the interaction. An infant laboratory also allows for standardization of camera angles. Some researchers have used camera systems which allow for a split screen view of both parent and child (Field et al., 1985; Hsu & Fogel, 2001; Jones, 2007). These cameras are located behind a two-way mirror allowing the interaction to occur without the presence of the researcher.

The researchers elected to conduct weekly 10-minute observations for 12 weeks. Due to the age of the infants being observed, it was determined that weekly observations would be adequate to allow developmental changes to be observed (Hsu & Fogel, 2001). The researchers initially intended to observe the mother-infant dyads for 6 months; however, due to time constraints the study was reduced to 12 weeks. It appears the frequency of observations and the length of each observation was adequate. The results of the present study did not show change in the behavior over time. It is not clear why this is the case. It may be that longer periods of observation over the course of the child's physical development may yield changes in "imitative classes".

Direction of Future Research

There are several avenues for future research. Osterling and Dawson (1994) suggested the deficit in imitation in children with autism is a result of a lack of attention. Therefore, a deficit in attending to the parents face may be an early sign of autism. The current research did not focus on the amount or direction of the infant attention. However, a deficit in imitation skills in children with autism may begin with absence of

attention to mother's face. Additionally, if attention to the face is critical, then increasing attention to the face through shaping and reinforcement may support imitation development.

While there has been some research into the reinforcers present in typical infant imitation development (Miller & Dollard, 1941; Parton, 1976; Poulson & Kymissis, 1998), more is needed. Miller and Dollard (1941) and Parton (1976) claim parents themselves function as a conditioned reinforcer. Poulson and Kymissis (1998) showed an increase in imitation when mothers delivered social praise. The current results show a higher rate of facial matches. Research by Klin & Jones (2008) suggests toddlers with autism do not look at faces. If the conditioned reinforcement theory is correct, the current research is in keeping with the theory that a deficit in social motivation may lead to a deficit in imitation in children with autism (Ingersoll et al., 2003; Trevarthen & Aitken, 2001). It is possible that the facial movements of parents or the parents in general function as a reinforcer. Further research into the factors leading to the deficit in imitation may contribute to autism intervention.

In addition to the research on the nature of the deficit in imitation in autism, information regarding the reinforcing elements would be beneficial to interventionists. Bandura conducted research in 1965 which showed reinforcing imitative behavior with candy not only increased the rate of imitation, but also conditioned the act of imitation as a reinforcer itself. Current interventions use social praise and food reinforcers to increase the rate of imitation in children with autism (Baer et al., 1967; Ganz, 2008; Ingersoll & Schreibman, 2006; Lewis, and Kroma, 2007). Future research exploring the

motivating and reinforcing aspects of imitation for children with autism may make interventions more effective.

While there are limitations to the current study, the preliminary research into the behaviors that appear in infants prior to imitation has shown infants do engage in Type, class, and out of class responses. Also, as they are physically able and as parents provide opportunities there are changes in the specific topographies. This not only informs interventionists in terms of typical imitation development, but also in application to autism intervention. As the field of autism treatment continues to develop, it is important that researchers continue to observe the development of neurotypically developing infants and parents in efforts to inform autism treatment and early detection of autism.

Table 1.

Methodological Review of Literature Involving Direct Observation of Parent-Child Dyad Interactions

Reference	**Purpose**	**Age at First Observation**	**Methods**			
			Observation Sequence	*Observation Setting*	*Recording Method*	*Vidoe Recording Equiptment*
Abravenel et al (1976)	Explore the sequence and charagetristics of imitation development and the roll attention plays.	6 months	Every 3 months from 6 to 18 months old	Mother modeled specific behaviors in an infant laboratory	28-120 seconds	Video camera filmed interactions through a one-way mirror
Field et al (1985)	The effects of maternal imitative and non-imitative behavior on the rate of infant smiles and vocalization.	3.5 months	One 6-minute observation	Unstructured sessions took place in a living room-like infant labrotory	Cole-Palmer Polygraph Event Recorder with 2-second interval	2 video cameras
Hart & Risley (1992)	Invistigate how children learn to talk.	6 months	1 hour observation, mothly for 2.5 years	Unstructured sessions took place in the home.	A computer determined type, frequency and duration	1 audio tape recorder, the observer present during the session also took notes on relevant information.

(table continues)

Table 1 *(continued).*

Landry et al. (1998)	Examin the changes in mothers' interaction as child develops	6 months	2 hour observation at 6, 12, 24, & 40 months of age	Unstructured observation in the home and included a 10 minute free play interaction.	Frequency data was taken during direct observation with a paper and pencil	None
Kokkinaki & Kugiumutzakis (2000)	Explore the aspects of vocal imitation	2 months	10 minute sessions, every 15 days, for 4 months	Unstructured sessions in the home	10 seconds	1 videp camera
Hsu (2001)	Study the development of vocalizations in infants as the dynamics of the mother-child dyad changes.	4 weeks	Weekly observations for an average of 16 weeks.	Unstructured observations were conducted in a labrotory play room.	1 second	3 remote controlled video cameras
Jonsson et al. (2001)	Examined how mothers' share feeling states to infants,	2 months	Monthly 15 minute observations	Unstructured observations in the home	Frequency data was collected and each occurance was rated on a scale.	1 video camera
Landry et al. (2001)	Studied the role of mother responsiveness on social and cognitive development.	6 months	70 minute observation at 6, 12, & 24 months, and 3.5 and 4.5 years	In home unstructured activities	Frequency data was collected and each occurance was rated on a scale.	None

(table continues)

Table 1 *(continued).*

Flynn et al. (2004)	Observed interpersonal factors that may predict verbal and action imintation	10 months	15 minute observations took place at 10, 13, 17, and 21 months of age	Unstructured free play in the home	Frequency during 10 S. intervals	Video camera
Markova & Legerstee (2006)	Examined the role that contingency, imitation, and affect sharing plays in the development of social awareness	4 weeks	3 minute observations took place at 4, 5, 12, & 13 weeks.	Natural and contrived interactions took place in an infant laboratory	Second by second data was collected and rated on a scale	None described
Jones (2007)	Investigated the development of infant's ability to reproduce 8 motor actions performed by parent.		One time observation	Mother modeled specific behaviors in an infant laboratory	10 seconds	2 remote controlled wall mounted video cameras

Table 2.

Pre- and Post-Participation Assessment Scores

The Rossetti	**Abbott (18 weeks)**	**Abbott (35 weeks)**	**Lucy (4 weeks)**	**Lucy (19 weeks)**
Interaction-Attachment	3-6 months	9-12 months	0-3 months	3-6 months
Pragmatics	3-6 months	9-12 months	0-3 months	6-9 months
Gesture	N/A	9-12 months	N/A	N/A
Play	3-6 months	9-12 months	0-3 months	6-9 months
Language Comprehension	3-6 months	9-12 months	0-3 months	6-9 months
Language Expression	3-6 months	6-9 months	0-3 months	6-9 months

Hawaiian Early Learning Profile	**Abbott (18 weeks)**	**Abbott (35 weeks)**	**Lucy (4 weeks)**	**Lucy (19 weeks)**
Cognitive	3.5-5 months	11 months	1-2 months	4-6 months
Expressive Language	5-7 months	6.5-8 months	1-5 months	5-7 months
Gross Motor	1.5-2 months	6-10.5 months	1.5-2.5 months	3-5 months
Fine Motor	4-5.5 months	5-10.5 months	2-3 months	4-5 months
Social-Emotional	4-8 months	6-9 months	1.5-4 months	5.5-8.5 months
Self-Help	3-5 months	9-12 months	3-5 months	6.5-9 months

Table 3.

Operational Definitions

Vocalizations

Measure	Definition
Child Directed Speech	*Child Directed Speech* is typically referred to as “baby talk”. It is simple and directed to infants. It uses more questions than declaratives, a musical intonation, high pitch, and, slow rate of speech.
Adult Directed Speech	*Adult Directed Speech* is a typical form of speech between two adults There are no modifications are made for the child. It uses a normal pitch and tone. It may be used in interactions with the child.
Singing	*Singing* occurs any time the parent or child sings songs or melodies. This includes chanting songs or melodies and humming songs or melodies
Babbling	*Babbling* occurs any time the parent or child engages in a repeated rhythmic alternations between the same open and closed mouth configurations (constant- vowel, constant-vowel).
Single Sound	A *single sound* occurs any time a single sound is produces. It can be a constant, vowel, or other oral sound. They can be given once or repeated.

Facial Movements

Measure	Definition
Smile	A *smile* occurs any time the corners of the mouth turn up. The mouth can be either open or closed.
Eye Movements	An *eye movement* occurs any time the eyes or eyebrows move in an exacerbated manner.
Mouth Movements	A *mouth movement* occurs when there is any movement of the mouth or lips. This may be accompanied with sounds.
Tongue Movements	A *tongue movement* occurs when there is any visible movement of the tongue. The tongue can be out of the mouth or in the mouth, or with the mouth open as long as the tongue can be seen.
Head Movements	A *head movement* occurs when there is any movement of the head by parent or infant.

(table continues)

Table 3 *(continued.)*

Motor Movements

Measure	Definition
Arm Movements	An *arm movement* occurs any time the parent or child moves their arm and it is not directed at an object or person.

Object Manipulation

Measure	Definition
Touch	A *touch* occurs any time the parent or infant comes into contact with a toy.
Rub	A *rub* occurs any time the parent or child moves their hand(s) across the surface of an object in a side-to-side or forward and backward motion.
Slap	A *slap* occurs anytime the parent or child moves their forearms in an upward then downward motion such that the palm or fingers of their hands strike the surface.
Bang	A *bang* occurs any time the parent or child holds a toy and moves their forearm(s) in an upward then down ward motion such that the object comes into contact with another object or surface.
Squeeze	A *squeeze* occurs anytime the mother or child applies pressure to a toy with their fingers or hands. The toy must be placed between 2 fingers or both hands or pushed onto a hard surface.
Shake	A shake occurs any time the parent or child holds a toy and moves their forearm(s) in an upward then down ward motion, but the toy does not come into contact with another object or surface.

Table 4.

Definitions for Derived Measures

Derived Measures			
Measure	**Definition**	**Interval**	**Conversion**
Type Match	A *Type* match occurs when a parent behavior is followed with an infant behavior of the same type and the infant behavior occurs during the same interval or within the 3 seconds following the parent behavior.	1 Second	$\frac{\text{Number of Matches}}{\text{\# of Valid Minutes}}$
Class Match	A *Class* match occurs when a parent behavior is followed with an infant behavior of the same class and the infant behavior occurs during the same interval or within the 3 seconds following the parent behavior.	1 Second	$\frac{\text{Number of Matches}}{\text{\# of Valid Minutes}}$
Out of Class Response	An *Out of Class* response occurs when a parent behavior is followed with an infant behavior from a different class and the infant behavior occurs during the same interval or within the 3 seconds following the parent behavior.	1 Second	$\frac{\text{Number of Matches}}{\text{\# of Valid Minutes}}$

Table 5.

Rules and Definitions for Scoring Invalid Intervals

Behavior Class	Rules and Definitions for Invalid Intervals
Parent and Child Vocalization	Any time the mother speaks to or interacts with a pet or another person, mark the entire interval for all behaviors invalid.
Parent Facial Movement	Parent eye movements have been taken out of the data pool. Mark them out, they will not be counted. All facial intervals are marked invalid if you cannot see the mouth clearly. You must be able to see lips move. If you cannot see the mouth clearly mark out the entire interval for parent facial.
Child Facial Movement	All facial intervals are marked invalid if you cannot see the mouth clearly. You must be able to see lips move. If you cannot see the mouth clearly mark out the entire interval for Child Facial. If the rest of the face is observable, do not mark intervals invalid if the child is chewing an item or body parts.
Parent and Child Motor Movement	Parent and child leg movements have been taken out of the data pool. Mark them out, they will not be counted. Mark motor intervals invalid if the no part of the arm observable to the camera.
Parent and Child Object Manipulation	Mark intervals invalid if the object being manipulated is out of view of the camera.
Other	Mark all behaviors in all behavior classes invalid any time the mothers back is facing the child or the Childs back is facing the mother.

Table 6.

Summary of Interobserver Agreement Scores

Vocalizations								
	Parent Vocalizations					Child Vocalizations		
Behavior Type	Sing	Adult Directed Talk	Child Directed Talk	Babbling	Single Sound	Sing	Babbling	Single Sound
Abbott Session 3	100.00	100.00	88.78	83.90	94.93	100.00	100.00	79.40
Abbott Session 6	100.00	100.00	80.00	100.00	95.58	100.00	100.00	80.5
Lucy Session 3	100.00	100.00	89.05	96.77	84.69	100.00	100.00	90.60
Lucy Session 8	96.43	100.00	93.59	90.91	91.25	100.00	100.00	93.48
Overall IOA	99.12	100.00	87.85	92.89	91.61	100.00	100.00	85.99

Facial Movements									
	Parent Facial Movement				Child Facial Movements				
Behavior Type	Smile	Mouth	Tongue	Head	Smile	Mouth	Tongue	Eyes	Head
Abbott Session 3	51.84	76.50	100.00	89.20	6.69	84.50	100.00	42.60	73.50
Abbott Session 6	66.67	96.30	100.00	47.40	64.10	55.40	100.00	94.10	92.9
Lucy Session 3	96.24	91.46	88.89	40.82	86.79	98.15	93.75	70.59	50.94
Lucy Session 8	97.403	91.6	100	74.69	58.08	97.37	100	54.55	89.92
Overall IOA	78.03	88.96	97.22	63.02	53.91	83.85	98.43	65.46	76.81

(table continues)

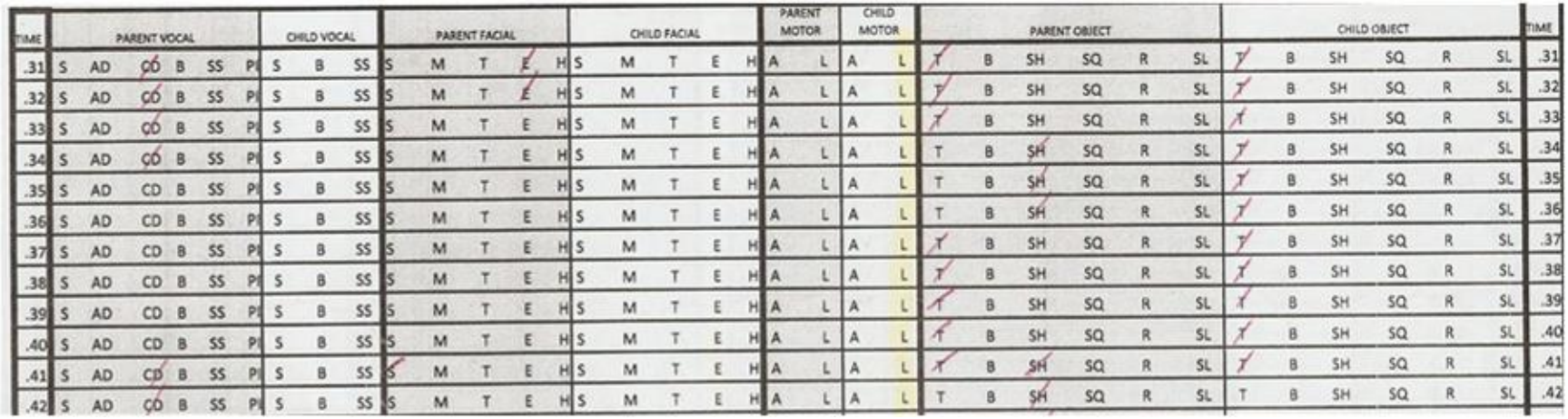
Table 6 *(continued).*

Motor Movement

	Parent Motor Movement	Child Motor Movement
Behavior Type	Arm	Arm
Abbott Session 3	80.55	70.92
Abbott Session 6	61.90	76.19
Lucy Session 3	36.78	97.54
Lucy Session 8	97.40	58.08
Overall IOA	69.16	75.68

Object Manipulation

	Parent Facial Movement						Child Facial Movements					
Behavior Type	Touch	Bang	Shake	Squeeze	Rub	Slap	Touch	Bang	Shake	Squeeze	Rub	Slap
Abbott Session 3	99.00	100.00	63.00	100.00	100.00	100.00	100.00	92.00	100.00	100.00	100.00	100.00
Abbott Session 6	92.00	100.00	84.00	100.00	100.00	80.00	57.00	100.00	86.00	100.00	100.00	95.00
Lucy Session 3	97.10	100.00	77.30	75.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Lucy Session 8	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Overall IOA	97.02	100	81.075	93.75	100	95	89.25	98	96.5	100	100	98.75



TIME	PARENT VOCAL	CHILD VOCAL	PARENT FACIAL	CHILD FACIAL	PARENT MOTOR	CHILD MOTOR	PARENT OBJECT	CHILD OBJECT	TIME
.31	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.31
.32	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.32
.33	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.33
.34	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.34
.35	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.35
.36	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.36
.37	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.37
.38	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.38
.39	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.39
.40	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.40
.41	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.41
.42	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.42

Figure 1. Derived data example.

For each second, or 3 seconds following the parent behavior, score the infant behavior in the correct category of the Derived Measures Data Sheet (Example Below). This data set yields the following derived data.

- Type Match
  - Touch Object-11
- Class Match
  - Touch Object-7
    - Matched with parent behavior Shaking Object-7
- Out Of Class Match
  - Touch Object-7
    - Matched with parent behavior Eye Movements-5
    - Matched with parent behavior Smile- 8
    - Matched with parent behavior Child Directed Talk-8

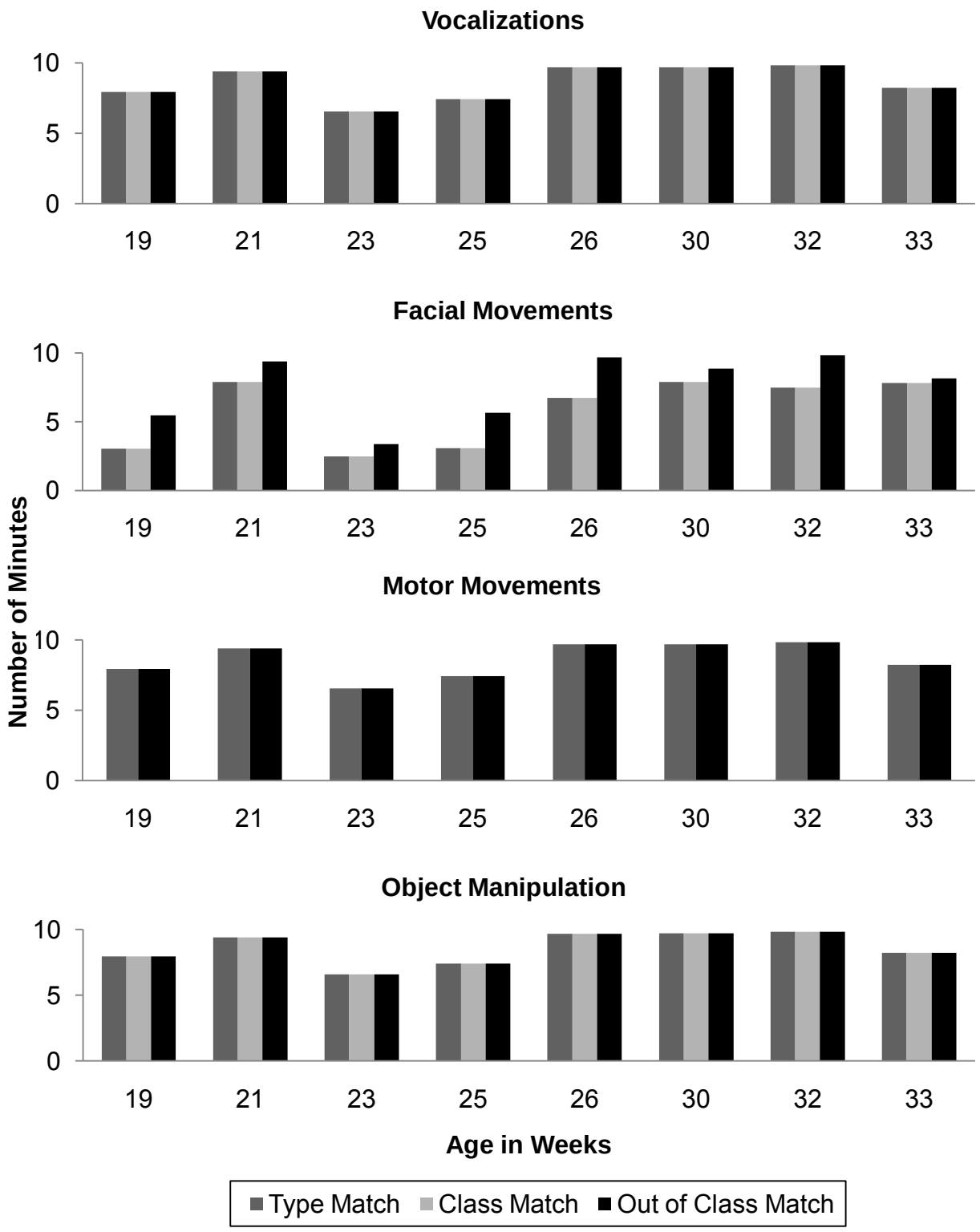


Figure 2. Abbott's total number of valid minutes.

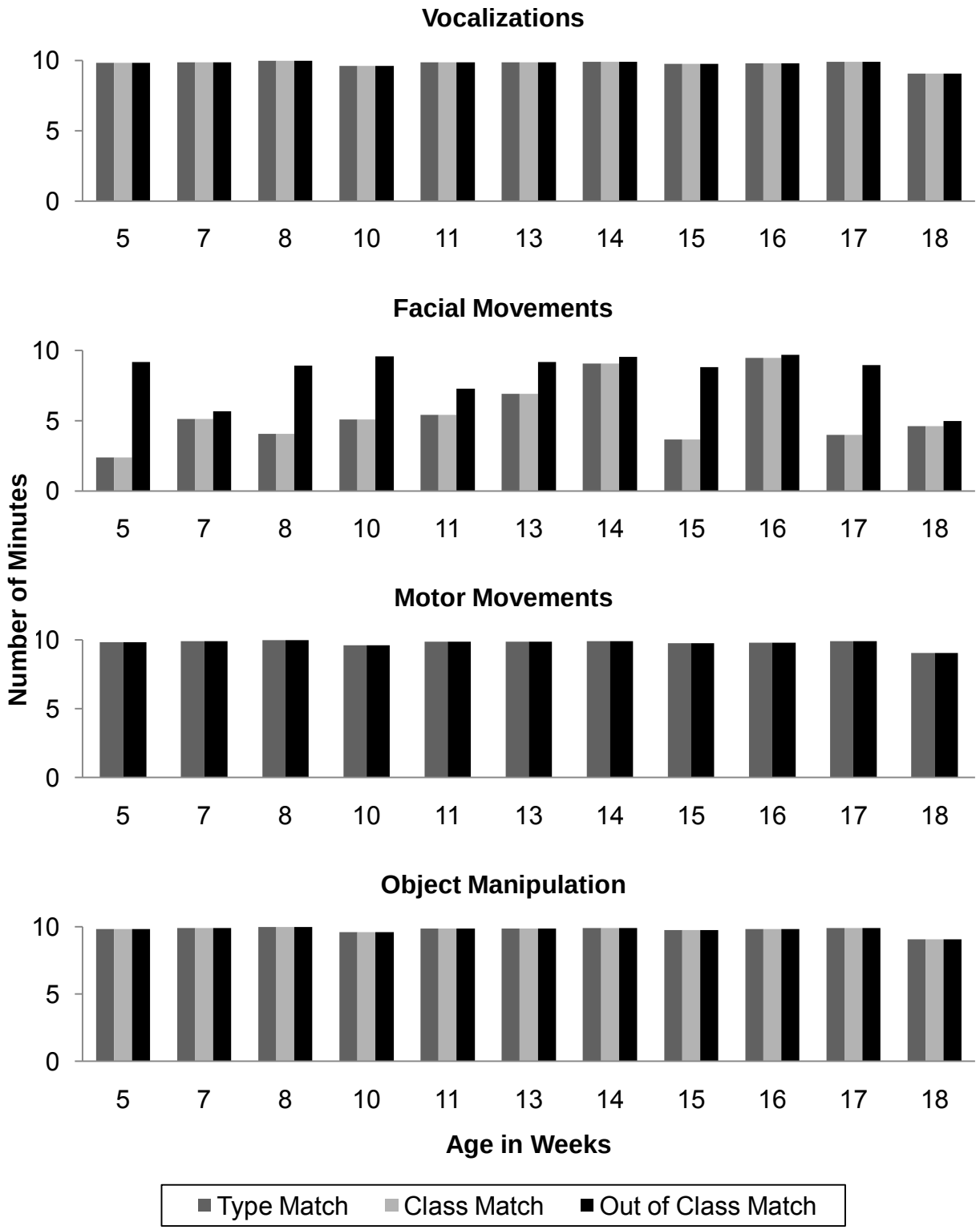


Figure 3. Lucy's total number of valid minutes.

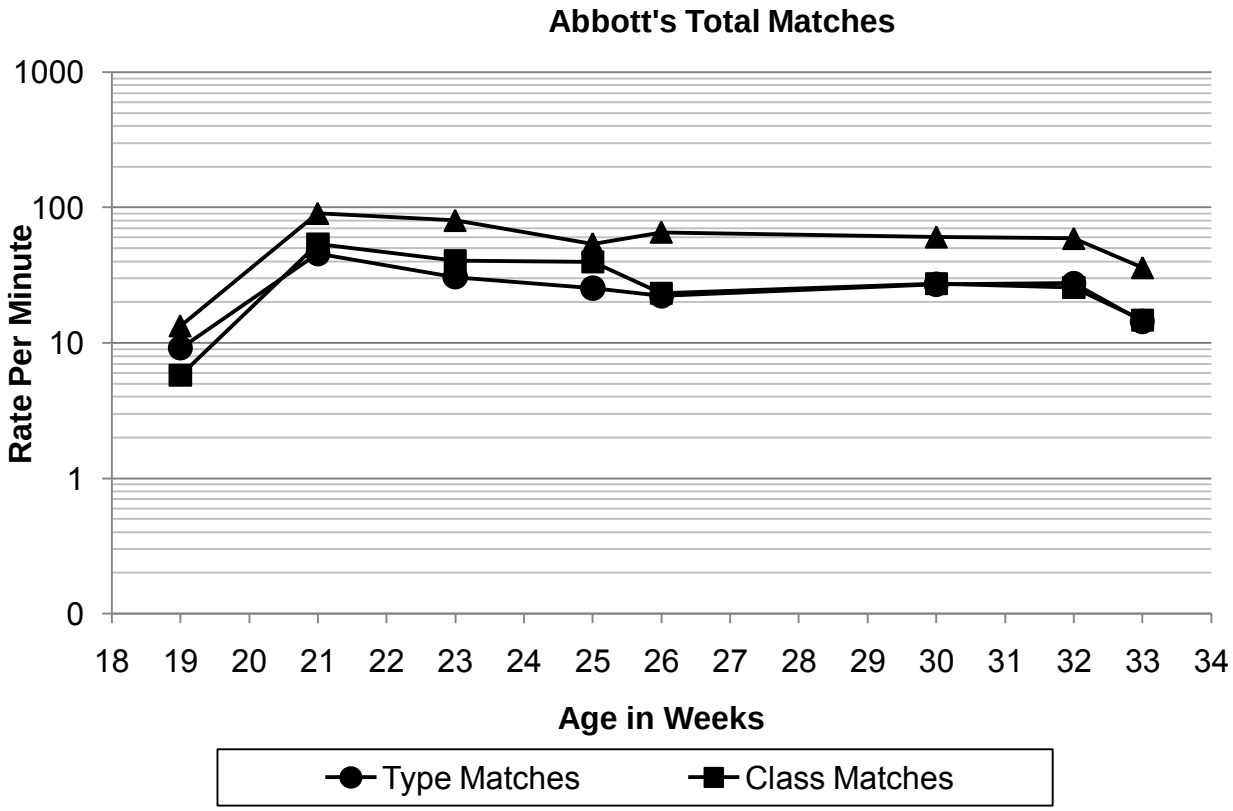


Figure 4. Abbott's rate of Type matches, *Class* matches, and *Out of Class* matches

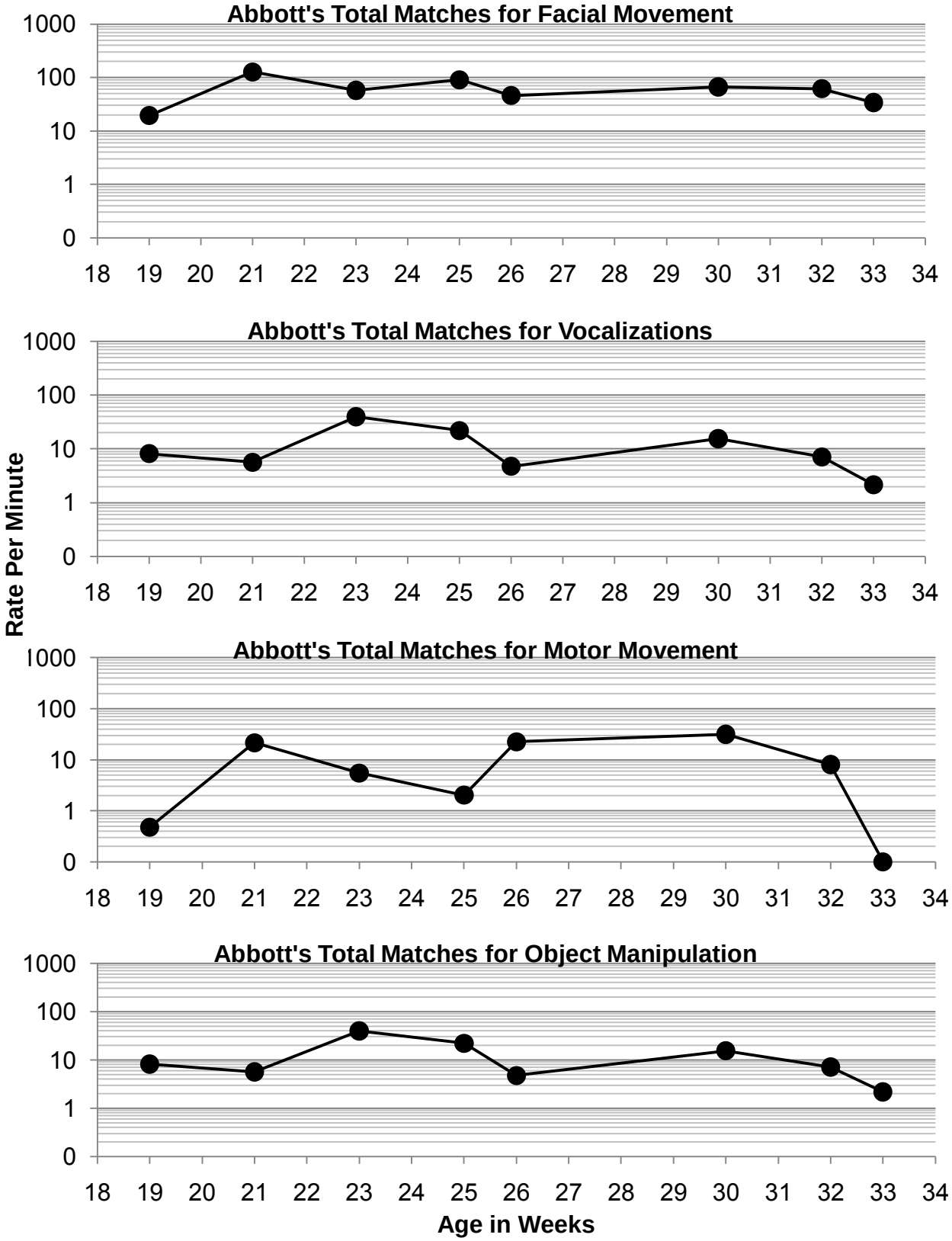


Figure 5. The rate of all behavior matches combined for Abbott's vocalizations, facial movements, motor movements, and object manipulations.

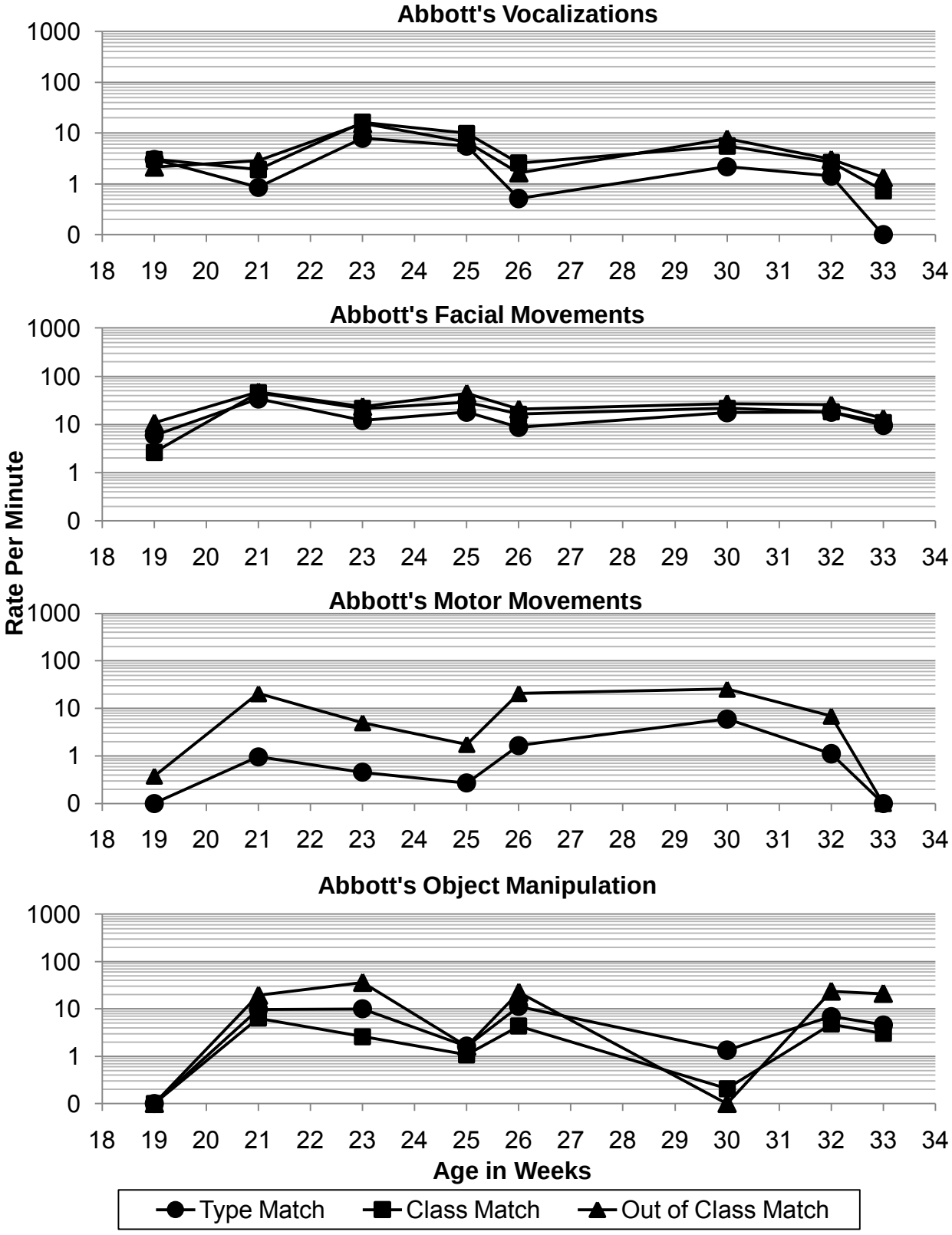


Figure 6. Abbott's rate per minute of the Type, *Class*, and *Out of Class* matches for vocalizations, facial movements, motor movement, and object manipulation.

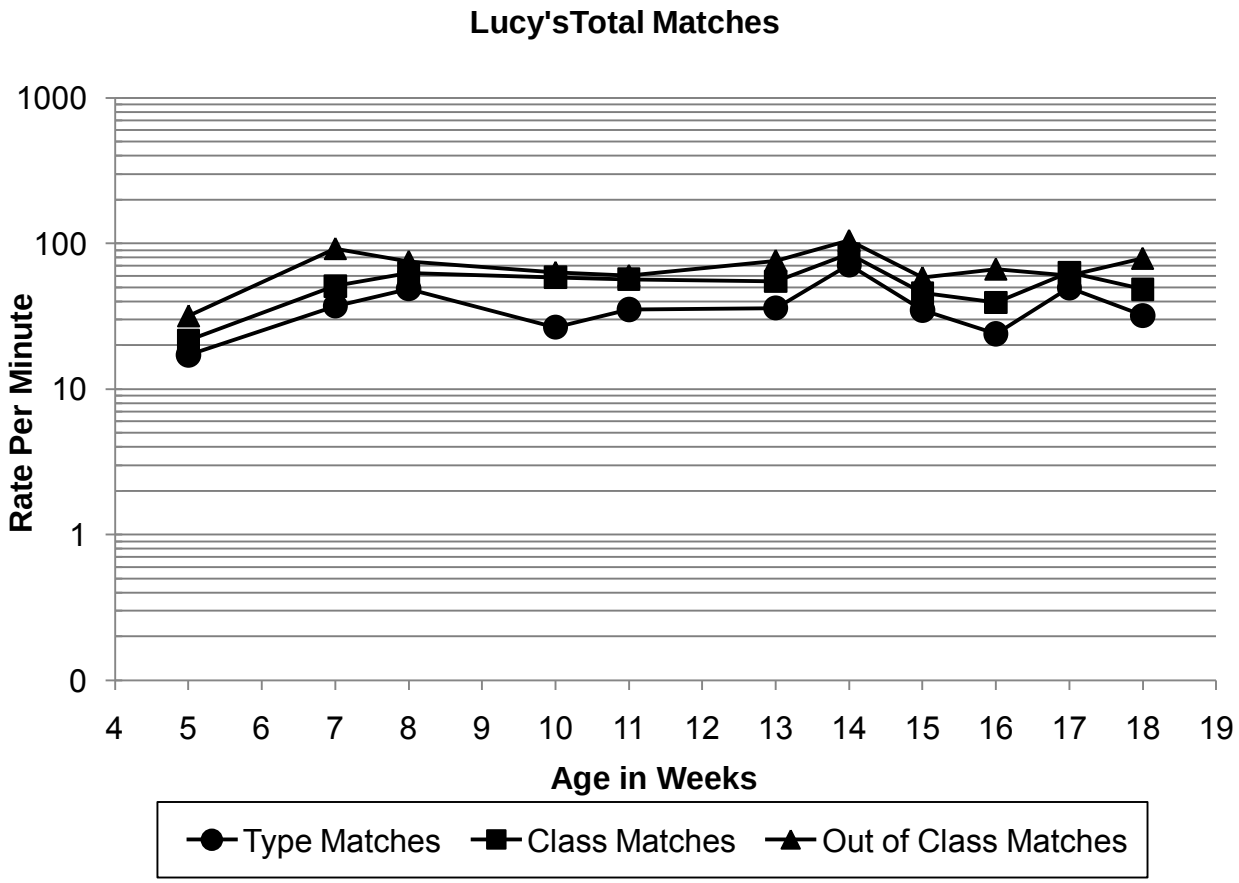


Figure 7. Lucy's rate of Type matches, *Class* matches, and *Out of Class* matches

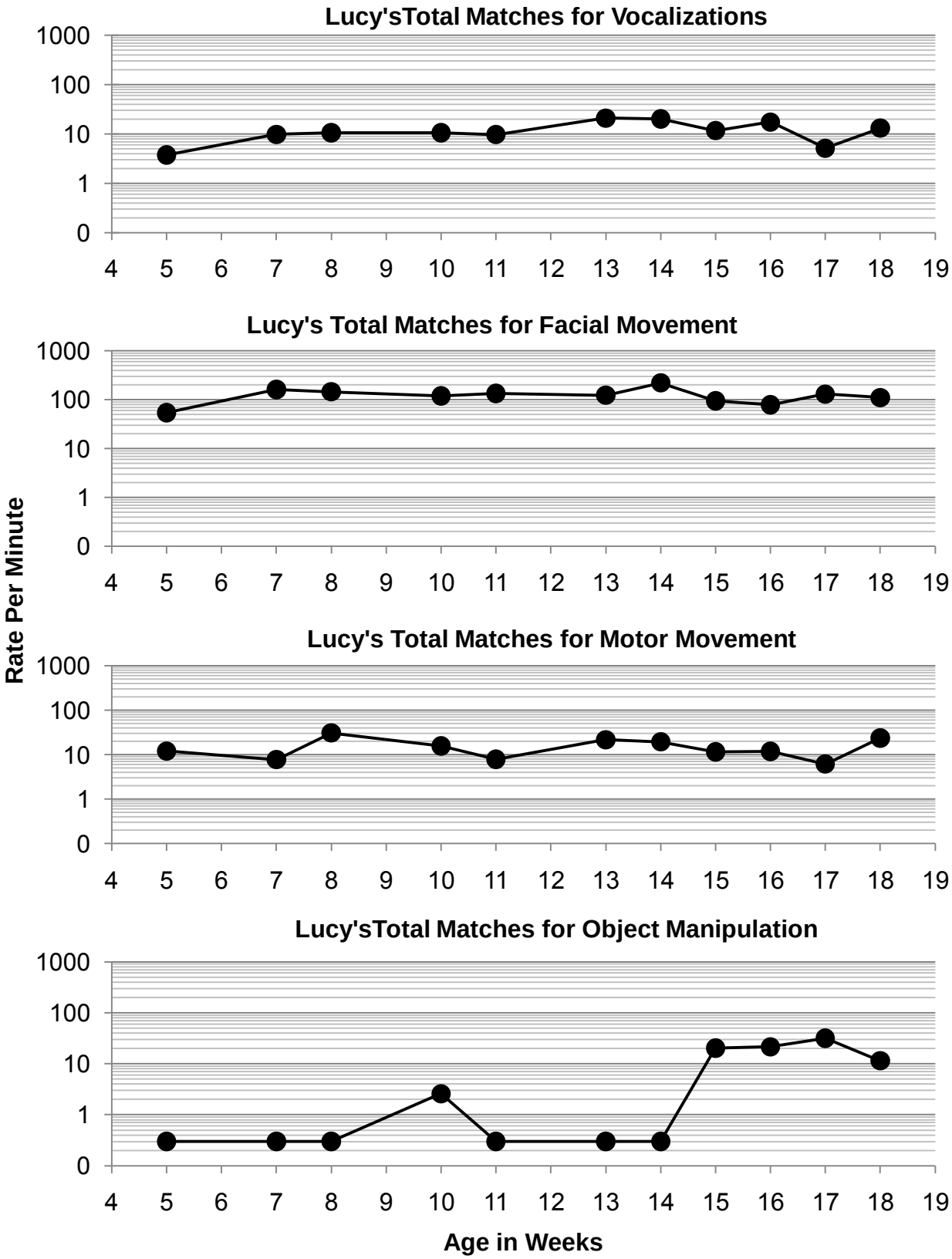


Figure 8. The rate of all behavior matches combined for Lucy's vocalizations, facial movements, motor movements, and object manipulations.

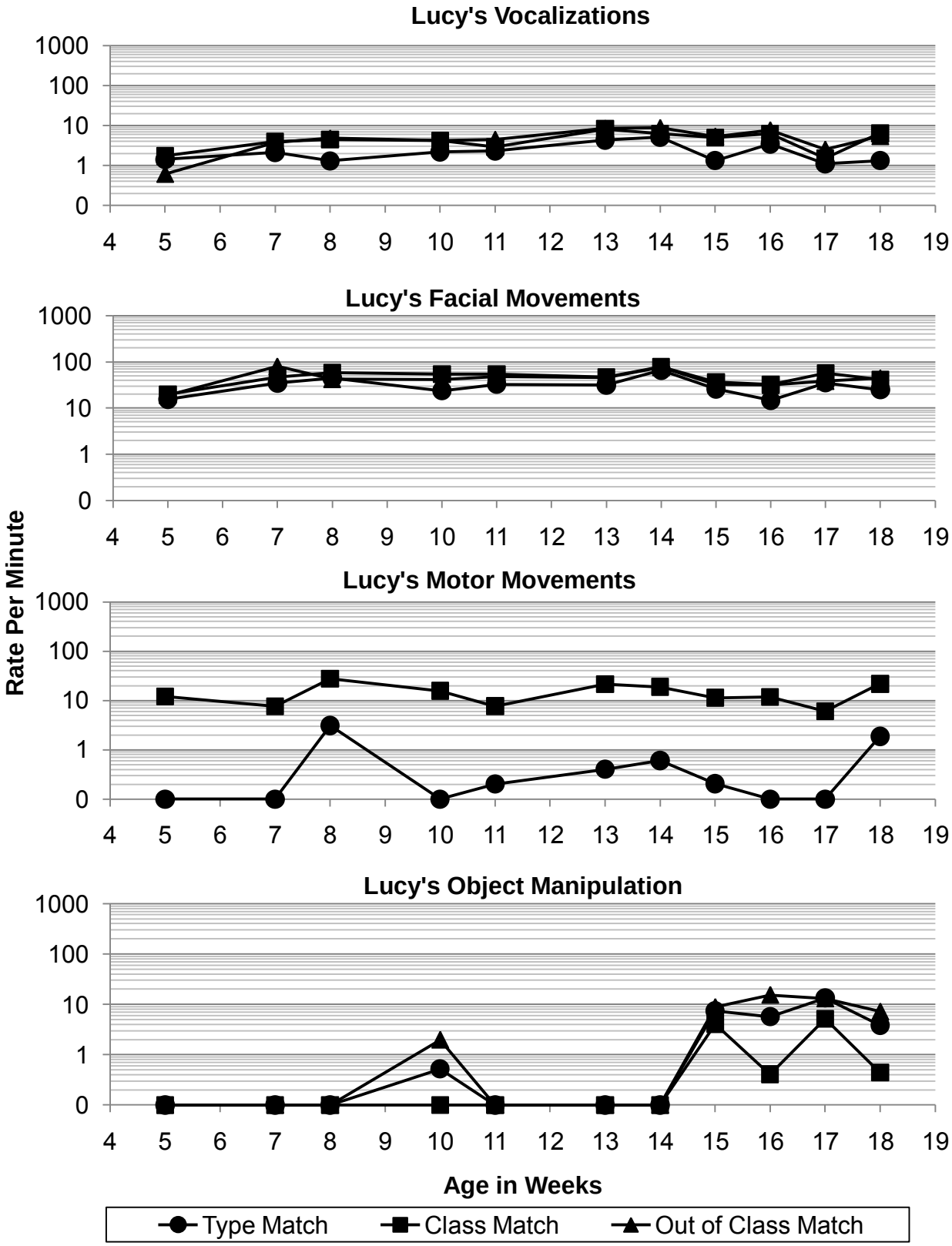


Figure 9. Lucy's rate per minute of the Type, *Class*, and *Out of Class* matches for vocalizations, facial movements, motor movement, and object manipulation.

APPENDIX A

FLYER USED TO RECRUIT PARTICIPANTS

Do you enjoy watching your child learn and develop?

If so, you may be interested in participating in a study on the development of social behaviors in infants. Babies and their parents in this study will be videotaped once per week for 6 consecutive months.

The purpose of this study is to see how social behaviors, such as joint attention and imitation, develop across time in typically developing children. If you are interested and your child is under 2 months of age, please contact Carley McAnally at [redacted] or at [redacted]

In gratitude for your time and contribution, each participating family will be presented with a musically enhanced, touching video of you and your child over the course of 6 months!

[redacted]

APPENDIX B

SAMPLE DATA SHEET

IMITATION DATA CARLEY WALTENBURG

CHILD:_____ DATA COLLECTOR:_____ IOA:_____

SESSION #:_____ DATE OF SESSION:_____ MINUTE #:_____

TIME	PARENT VOCAL	CHILD VOCAL	PARENT FACIAL	CHILD FACIAL	PARENT MOTOR	CHILD MOTOR	PARENT OBJECT	CHILD OBJECT	TIME
.31	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.31
.32	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.32
.33	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.33
.34	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.34
.35	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.35
.36	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.36
.37	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.37
.38	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.38
.39	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.39
.40	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.40
.41	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.41
.42	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.42
.43	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.43
.44	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.44
.45	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.45
.46	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.46
.47	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.47
.48	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.48
.49	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.49
.50	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.50
.51	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.51
.52	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.52
.53	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.53
.54	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.54
.55	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.55
.56	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.56
.57	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.57
.58	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.58
.59	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.59
.60	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.60

S-SING
AD-ADULT DIRECTED TALK
CD-CHILD DIRECTED TALK
B-BABBLING
SS- SINGLE SOUNDS
PI-PARENT IMITATION

S-SMILE
M-MOUTH
T-TONGUE
E-EYES
H-HEAD

A-ARM
L-LEG

T- TOUCH
B-BANG
SH-SHAKE
SQ- SQUEEZE
R-RUB
SL-SLAP

APPENDIX C

INFORMED CONCENT FORM

UNT
UNIVERSITY OF
NORTH TEXAS

OFFICE OF THE VICE PRESIDENT FOR RESEARCH
Office of Research Services

April 25, 2008

Nicole Stichomel
Department of Behavior Analysis
University of North Texas

Re: Human Subjects Application No. 08-105

Dear Ms. Stichomel:

As permitted by federal law and regulations governing the use of human subjects in research projects (45 CFR 46), the UNT Institutional Review Board has reviewed your proposed project titled "Development of an Observation System to Measure Joint Attention." The risks inherent in this research are minimal, and the potential benefits to the subject outweigh those risks. The submitted protocol is hereby approved for the use of human subjects in this study. **Federal Policy 45 CFR 46.109(e) stipulates that IRB approval is for one year only, April 25, 2008 to April 24, 2009.**

Enclosed is the consent document with stamped IRB approval. Please copy and **use this form only** for your study subjects.

It is your responsibility according to U.S. Department of Health and Human Services regulations to submit annual and terminal progress reports to the IRB for this project. Please mark your calendar accordingly. The IRB must also review this project prior to any modifications.

Please contact Sheila Bourns, Research Compliance Administrator, or Boyd Herndon, Director of Research Compliance, at extension 2430, if you wish to make changes or need additional information.

Sincerely,

Kenneth W. Sewell, Ph.D.
Chair
Institutional Review Board

KS:sb
CC: Dr. Shahla Ala'I Rosales

P.O. Box 305250 | Denton, Texas 76203-5250 | TEL 940.565.3940 | FAX 940.565.4777 | TTY 940.369.7652 | www.unt.edu

University of North Texas Institutional Review Board

Informed Consent Form

Before agreeing to you and your child's participation in this research study, it is important that you read and understand the following explanation of the purpose and benefits of the study, as well as how it will be conducted.

Title of Study: Development of an Observation System to Measure Joint Attention

Principle Investigator: Nicole Suchomel, University of North Texas, Department of Behavior Analysis

Purpose of the Study: You and your child are being asked to participate in a research study designed to identify and measure attention-seeking and attention sharing (joint attention) behaviors in infants. My goal is to develop a measurement system that reliably counts skills related to joint attention (eye contact, smiles, gaze shifts, vocalizations, imitations, hand movements) in the natural environment. Joint attention is defined as the ability to coordinate attention between an object and another person in a social context. Joint attention can be thought of as a social interaction between child and adult that involves sharing, following, and/or directing attention by pointing or gazing. It has been documented that typically developing children exhibit joint attention around 12 to 15 months of age. The first signs of joint attention will begin around the 9th month of age and continue until the 15th month of age. My hope is that this observation system will capture joint attention as it emerges in an individual child. I am interested in joint attention because it is thought to be one of the earliest social behaviors. Children with autism spectrum disorders, which is my area of study, have profound deficits in social skill development, language development, imitation skills, and play skills. One of the most pronounced deficits typically lies in the area of social skill development. Children with autism usually need to be taught how to engage in and respond to socially appropriate behavior. The behaviors of interest will be counted by graduate students in the department of behavior analysis and analyzed in order to answer the two experimental questions. In order to better serve children with autism, I am trying to answer these questions. The first question is: are there clear, identifiable attention-seeking behaviors that appear in infants prior to joint attention? The second question is: Can prerequisite attention-seeking joint attention behaviors be reliably and consistently measured in an infant's natural environment? This information should help us better design teaching programs for children with autism.

Study Procedures: My interest is in documenting the development of joint attention in typically developing children. For that reason, before your child participates in the study as well as at the completion of the study, a developmental screening, provided by a faculty member at the University of North Texas, will need to be conducted. This screening will document your child's developmental profile at the beginning and end of the experiment. You will be provided with a copy of the results and if there are any

concerns regarding your child's development, we will provide you with the necessary information to pursue further evaluation.
You and your child will be asked to engage in a typical playtime session that will take about 10 minutes a day, every week, for 6 months. The procedure involves a 10-minute videotaped playtime session of you and your child interacting. All videotaped sessions will take place at the child's daycare or home.

Voluntary Participation: Participation in this research study is voluntary. Refusal to participate or a decision to discontinue participation will not involve a penalty or loss of benefits to which you are otherwise entitled.

Foreseeable Risks: No foreseeable risks are involved in this study. Previous clinical and research reports have identified no harm from participation in studies of this caliber.

Benefits to the Subject or Others: This study is not expected to be of any direct benefit to you or your child; however, the results of the study may benefit future caregiver-child pairs in identifying, measuring, and teaching attention seeking and attention sharing skills in children with autism. The results of this study may directly add to the knowledge of other service providers delivering services to families with children with autism and other populations.

Compensation: Shortly after the experiment is complete, you will receive a composite of all of the video footage of you and your child over the course of six months. We hope that this will make your support of the project worthwhile.

Procedures for Maintaining Confidentiality of Research Records: All records including signed consent forms and video tapes will be kept in a locked filing cabinet in Dr. Shahla Ala'i-Rosales' office in Chilton Hall Rm. 360. No documents will be posted on the internet and any electronic copies will be given to the family immediately upon completion of the study. All research participants will be given a pseudonym that will be used when referring to that participant's data and will be maintained throughout the course of research. Following the research study, all personally identifiable data will be marked with the participant's pseudonym and remain in The Department of Behavior Analysis records for at least 3 calendar years. Because of the extensive data collection involved in the research study, a team of graduate student may view the participants' records at any time during and after the study. All of these graduate students are supervised by Dr. Shahla Ala'i-Rosales. Personally identifiable data will not be disclosed to anyone outside of The Department of Behavior Analysis. The confidentially of the participants' personal information will be maintained in the master's thesis defense and in any public dissemination, such as appearance in academic journals and/or academic conferences.

Questions about the Study
If you have any questions about the study, you may contact [redacted] at [redacted].

Review for the Protection of Participants: This research study has been reviewed and approved by the UNT Institutional Review Board (IRB). The UNT IRB can be contacted at (940) 565-3940 with any questions regarding the rights of research subjects.

Research Participants' Rights: Your signature below indicates that you have read or have had read to you, all of the above and that you confirm all of the following:
Nicole Sudhoff and/or Carley McAnally have explained the study to you and answered all of your questions. You have been told the possible benefits and the potential risks and/or discomforts of the study.
You understand that you and your child do not have to take part in this study, and your refusal to participate or your decision to withdraw will involve no penalty or loss of rights or benefits. The study personnel may choose to stop your participation at any time.
You understand why the study is being conducted and how it will be performed.
You understand your rights as a research participant and you voluntarily consent to participate in this study.
You have been told you will receive a copy of this form.

Printed Name of Child

Signature of Parent | Date

For the Principal Investigator or Designee: I certify that I have reviewed the contents of this form with the participant signing above. I have explained the possible benefits and the potential risks and/or discomforts of the study. It is my opinion that the participant understood the explanation.

Signature of Principal Investigator or Designee | Date

APPROVED BY THE UNT IRB
FROM 4/25/09 TO 4/24/09

APPENDIX D

PARENT QUESTIONAIRE

Parent Questionnaire

Child:_____

1. Mothers Name

2. Fathers Name

3. Address

4. Phone Number

5. What is the best time of day for you and your child to participate in the 10 minute play session?

6. Names and ages of other Children

    a. Can the other children be occupied during the 10 minute playtime session?

7. Names of any other people living/visiting in the home

8. Where do you prefer us to park?

9. Are there any house rules we should know about?
    a. Shoes in the house:
    b. Knock or ring the doorbell:
    c. Drinks (water):

10. Do you have any pets?

11. Severe allergies of any family members?

12. Questions or concerns of parent:

APPENDIX E

INSTRUCTIONS TO PARENTS

Protocol
Instruction to Parents

- You are welcome to ask any questions before and after the 10 minute playtime session.
- We are not allowed to talk to you during the 10 minute playtime session
- We are not allowed to give you any sort of feedback regarding your interaction with your child.
- We will reserve 1 hour for the playtime session and any questions or comments you may have. You are welcome to use the entire hour for questions or comments, or you may choose to just complete the 10 minute playtime session and we will leave. Please let us know your preference.
- We are not allowed to engage in play interaction with any of your children. While we would love to play with all of the children, it may affect the goals of this thesis.
- **Scheduling assessments and meetings prior to assessment (intake).**

APPENDIX F

OBSERVER PROTOCOL

Observer Protocol

Day before Session

- Call to confirm scheduled session.

Prior to Arrival

- Always arrive on time!
- Dress appropriately.
- Call Carley/Nicky when arriving and leaving the house EVERY time!
- Do not leave cell phone ringer on when in the house.
- Review parent questionnaire.
- Review session log from previous session.
- Maintain confidentiality at all times.
- *Non-therapeutic relationship dynamics??*
- *Can we hold the babies without modeling interaction??*
- Make sure all materials (camera, session log, battery, tri-pod, etc) are available and ready.

In the Home

- Greet family members.
- Follow house rules (take off shoes, no drinks, etc).
- Set up the camera.

During the Playtime Session

- Always video a sheet of paper with date, time, session number—write clearly and with a pen.
- State clearly when time starts and stops. Specifically say “Time is starting” and “Time is up”.
- Keep track of time!
- Do NOT speak to anyone during the 10 minute session!
- Carley and Nicky CANNOT react to the parent and child interaction in anyway!
- After the session is up, do NOT give feedback!

After the Playtime Session

- Clean up the camera and datasheet.
- Ask the family if they have any questions prior to leaving.
- Thank the family for their time.
- Make sure to confirm the next session prior to leaving.

APPENDIX G

PLAY TIME LOG

Play Time Log

Child/Parent:_____

Observer:_____

Date:_____ **Session #**_____

Time In:_____ **Time Out**:_____

Notes:_____
_____
_____
_____
_____
_____
_____
_____
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_____
_____
_____
_____
_____
_____

Next Scheduled Session: _____

APPENDIX H

POST-PARTICIPATION QUESTIONNAIRE

Post Participation Questionnaire

This questionnaire was designed to help us describe the families that have participated in our study. We hope that providing this information when we describe the procedures and outcomes of this study will help other families and family interventionists. Thanks for your support!

ALL INFORMATION WILL REMAIN CONFIDENTIAL.

Child's Name _____Date of Birth _____

How old was your child (in weeks) at the beginning of this study? _____

How old was your child (in weeks) at the end of this study? _____

Mother's age (at beginning of study): _____

Mother's occupation: _____
Circle and Complete:

High School Degree

Bachelor's Degree in: _____

Master's Degree in: _____

Doctoral Degree in: _____

How would you best describe your ethnicity? _____

Father's age (at beginning of study): _____

Father's occupation: _____
Circle and Complete:

High School Degree

Bachelor's Degree in: _____

Master's Degree in: _____

Doctoral Degree in: _____

How would you best describe your spouses' ethnicity? _____

What is your annual income (circle)?

under $50,000 $50,000-75,000 $75,000-100,000 $100,000-125, 000 over $125,000

Please describe your experience with our study.

What did you like best about participating in the study?

What did you like least about participating in the study?

What would you change and how would you like to see it changed?

Would you and your family consider participating in a study like this again?

Additional Comments:

APPENDIX I

MOTHER SATISFACTION RESPONSES

Question	Abbott/Samantha	Lucy/Lola
1. What did you like best about participating in this study?	Seeing the author on a weekly basis ☺ Having the developmental screenings and the DVD at the end.	It was fun to have play sessions recorded of Lucy and me.
2. What did you like least about participating in this study?	Nothing—everything was very easy and flexible to our schedules. The authors were very sweet and professional.	That it didn't last longer. ☺
3. What would you change and how would you like to see it changed?	I hate not writing anything because I want to be constructive for the authors, but I truly couldn't think of anything to say. Sorry!	
4. Would you and your family consider participating in a study like this again?	Yes.	Absolutely.
5. Additional Comments		The authors were both pleasant fantastic ladies to work with!!!

APPENDIX J

IMITATION BEHAVIORAL DEFINITION CODE

Imitation Behavioral Definition Code
Table of Contents

VOCALIZATIONS

Child Directed Speech (CD):

This is typically referred to as "baby talk"

- Simple (more repetition and shorter utterances)
- Directed to infants (attends to what is meaningful or of interest to the infant)
- More questions than declaratives (mother asks more rhetorical questions than she makes statements or assertions)
- Musical (rhythmic pattern of speech)
- High pitch
- Slow rate of speech (words are spoken slowly or drawn out)

*adapted from *Beyond Baby Talk* & Butler et al, 2003

Examples:

- "how DO baBY" (pitch is higher for caps letters)
- "Ohhh. I sowy your tum tum howts"

Non-examples:

- "Do you want to eat?" (said in typical everyday voice)
- Laughing

Adult Directed Speech (AD):

Typical form of speech between two adults

- No modifications are made for the child.
- Normal pitch and tone (the voice is the same as she would normally speak)
- May be used in interactions with the child.
- Do not score mom talking to the dog.

Examples:

- "Do you want to eat?" (said in typical everyday voice)

Non-examples:

- "how DO baBY" (pitch his higher for caps letters)
- "Ohhh. I sowy your tum tum howts"

Singing (S):

Singing songs or melodies, Chanting songs or melodies, Humming songs or melodies

Examples:
Mom signs itsy bitsy spider
Mom chants "pat-a-cake"

Non-examples:
Mom repeats "ma ma" over and over

Babbling (B):

Repeated rhythmic alternations between the same open and closed mouth configurations. Consonant-

Examples:
"bababababa"
"mamamamama"

vowel, consonant-vowel.

Non-examples:
"oooooooooo"
"eeeeeeeeeee"

Single Sounds(SS):

Any single sound. Can be a constant, vowel, or other oral sound. They can be given once or repeated. For Laughing, mark the "ss" on the data sheet with an "L".

Examples:
- "aaaaaaaaa"
- "raspberries"
- kissing sound
- "gooing".
- "mmmmmmm"
- Laughing

Non-examples:
- Crying
- Coughing
- hiccups.

FACIAL MOVEMENTS

Mouth:

Any movements of the mouth or lips.
- May be accompanied with sounds. Does not include mouth movements during crying.
- Include kiss.

Examples:
- Mom kisses baby
- mom says "oooooo" with lips in o position

Non-examples:
- Baby says "ba ba ba"
- Baby opens mouth while crying

Smile:

Corners of the mouth turned up.
- Mouth can be either open or closed.

(DeQuinzio et al., 2007)

Examples:
- Mom smiles with lips together
- Baby smiles with an open mouth
- Baby laughs and smiles

Non-examples:
- Mom frowns when baby cries

Tongue:

movements of the tongue

- tongue out of mouth
- tongue in mouth with mouth open so tongue can be seen
- May be accompanied with sounds

Examples:

- Mother sticks tongue out and moves it from side to side
- Baby sticks tongue out and spits
- Baby opens mouth wide and moves tongue form one side of the mouth to the other

Non-examples:

- Mother says “I love you” slowly and tongue moves around mouth
- Baby moves tongue around inside mouth and the mouth is closed.

Eyes/eyebrows:

any movements of the eyes or eyebrows

Examples:

- eyes opened wider than normal
- Eyes blink fast
- Eyebrow raise

Non-examples:

- Blinking
- Squinting due to bright light
- Tracking objects
- Staring at objects or people

Head movements:

Any movements of the head by parent or infant

- nodding head
- shaking head

Does not include head dropping due to inability to hold the head up.

.

Examples:

- turning the head to look at an object
- Nodding or shaking the head in anticipation or excitement

Non-examples:

- head drops due to in-ability to hold the head up

BODY MOVEMENTS

Arm(A):

Any arm movements which are not directed at an

Examples:

object or person. Does not include baby grabbing their own feet.	• Baby moves arms while laying down • Mom moves arms up and down like wings Non-examples: • Baby moves arms to reach for a toy • Mother moves arms to pick up the baby
OBJECT MANIPULATION	
Touch: any time the parent or infant comes into contact with a toy. (Bourgeois et al., 2005)	Examples: • Mom picks up a toy • Baby reaches and touches the toy Non-examples: • Baby reaches for but never grabs the toy • Mom picks up the bottle
Shake (SH): the child or mother holds a toy and moves their forearm(s) in an upward then down ward motion, but the toy does not come into contact with another object or surface. (Bourgeois et al., 2005)	Examples: • Baby moves a rattle up and down Non-examples: • Mom shakes the bottle before feeding
Bang(B): The child or mother holds a toy and moves their forearm(s) in an upward then down ward motion such that the object comes into contact with another object or surface. (Bourgeois et al., 2005)	Examples: • Baby bands the rattle onto the table • Mom hits the bear on the head with the toy hammer Non-examples: • Mom bangs her hand on the table
Squeeze(SQ): The child or mother applies pressure to a toy with their fingers or hands. The toy must be placed between 2 fingers or both hands or pushed onto a	Examples: • Mom pushes the tummy of a toy bear and it squeaks • Baby squeezes the toy fish

hard surface. (Bourgeois et al., 2005)	between both hands and it squeaks Non-examples: • baby shakes the hammer • mom bangs the toy on the table
Slapping(SL): Child or mother moves their forearms in an upward then downward motion such that the palm or fingers of their hands struck the surface. (Bourgeois et al., 2005)	Examples: • Mom slaps hand onto the floor • Baby slaps hands onto the table Non-examples: • Mom bangs a toy onto the floor
Rubbing(R): Child or mother moves their hand(s) across the surface in a side-to-side or forward and backward motion. (Bourgeois et al., 2005)	Examples: • Mom rubs the teddy bears tummy • Baby rubs the soft pages of a book Non-examples: • Mom rubs babys tummy • Mom wipes spit off babies face

Derived Counts

Type Match:

Type Is defined as a specific topography of responses. The types include: babbling, laughing, single sound, singing, mouth movement, eye movements, head movements, tongue movements, smiling, arm movements, touching object, banging object, slapping object, shaking object, squeezing object, and rubbing object.

A type match occurs when a parent behavior is matched with an infant behavior of the same type and the infant behavior occurs during the same interval or within the 3 seconds following the parent behavior.

Example:
- Mother makes “single sound”—baby makes “single sound”
- Baby moves arms—mother moves arms

Non-Examples:
- Mother rubs the toy—baby shakes the toy
- Baby say “ooo”—mother claps

Class Match:

Classes are defined here as specific groupings of topographies (i.e. facial class, vocal class, motor class, and object manipulation)

A Class match occurs when a parent behavior is matched with an infant behavior of the same class and the infant behavior occurs during the same interval or within the 3 seconds following the parent behavior.

Example:
- Mother sticks tongue out—baby smiles
- Mother rubs the toy—baby shakes the toy

Non-Example:
- Baby say “ooo”—mother claps
- Mother says “bababa”—baby says “bababa”

Out of Class Response:

An Out of Class Match occurs when a parent behavior is matched with an infant behavior from a different class and the infant behavior occurs during the same interval or within the 3 seconds following the parent behavior.

Example:
- Mother smiles—baby kicks legs
- Baby say “ooo”—mother claps

Non-Example
- Mother says “bababa”—baby says “bababa”
- Mother sticks tongue out—baby smiles

Scoring Instructions

Each child behavior can be scored as a type match, class match, and out of class match. Each child behavior may only be scored one time in each of these categories.

Invalid Intervals

For intervals in which a behavior cannot be observed due to the camera angle, mark with a highlighter. Those intervals will not be counted in the data pool for the specific behaviors they affect. Mark all behaviors in all behavior classes invalid any time the mothers back is facing the child or the Childs back is facing the mother.

Parent and Child Vocalization

Any time the mother speaks to or interacts with a pet or another person, mark the entire interval for all behaviors invalid.

Parent Facial Movement

Parent eye movements have been taken out of the data pool. Mark them out, they will not be counted. All facial intervals are marked invalid if you cannot see the mouth clearly. You must be able to see lips move. If you cannot see the mouth clearly mark out the entire interval for parent facial.

Child Facial Movement

All facial intervals are marked invalid if you cannot see the mouth clearly. You must be able to see lips move. If you cannot see the mouth clearly mark out the entire interval for Child Facial. If the rest of the face is observable, do not mark intervals invalid if the child is chewing an item or body parts.

Parent and Child Motor Movement

Parent and child leg movements have been taken out of the data pool. Mark them out, they will not be counted. Mark motor intervals invalid if the no part of the arm observable to the camera.

Parent and Child Object Manipulation

Mark intervals invalid if the object being manipulated is out of view of the camera.

Calculating the number of valid intervals

- Facial
    - Type- the number of facial intervals which are valid for both parent and child.
    - Class- the number of facial intervals which are valid for both parent and child.
    - Out of Class- the number of valid intervals for child facial movements

- Vocal
    - Type-the number of valid vocal intervals which are valid for both parent and child.

    - Class- the number of valid vocal intervals which are valid for both parent and child.
    - Out of Class- the number of valid intervals for child facial movement

- Motor
    - Type- the number of motor intervals which are valid for both parent and child.
    - Class- N/A
    - Out of Class- the number of valid intervals for child motor movement

- Object
    - Type- the number of Object intervals which are valid for both parent and child.
    - Class- the number of Object intervals which are valid for both parent and child.
    - Out of Class-the number of valid intervals for child object manipulation

Basic Scoring Instructions

- For both parent and child behavior, put a "/" diagonal like though the behavior for each second it occurs.
- If no behavior of interest occurs, leave that second blank

TIME	PARENT VOCAL	CHILD VOCAL	PARENT FACIAL	CHILD FACIAL	PARENT MOTOR	CHILD MOTOR	PARENT OBJECT	CHILD OBJECT	TIME
.01	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.01
.02	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.02
.03	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.03
.04	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.04
.05	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.05
.06	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.06
.07	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.07
.08	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.08
.09	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.09
.10	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.10

In this data set, the parent and child were vocalizing during seconds 1-3, the mother was vocalizing during 4-5, baby was vocalizing during seconds 6-8, no vocalizations occurred during seconds 9-10.

Scoring Prompted Behavior

TIME	PARENT VOCAL	CHILD VOCAL	PARENT FACIAL	CHILD FACIAL	PARENT MOTOR	CHILD MOTOR	PARENT OBJECT	CHILD OBJECT	TIME
.01	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.01
.02	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.02
.03	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.03
.04	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.04
.05	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.05
.06	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.06
.07	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.07
.08	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.08
.09	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.09
.10	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.10

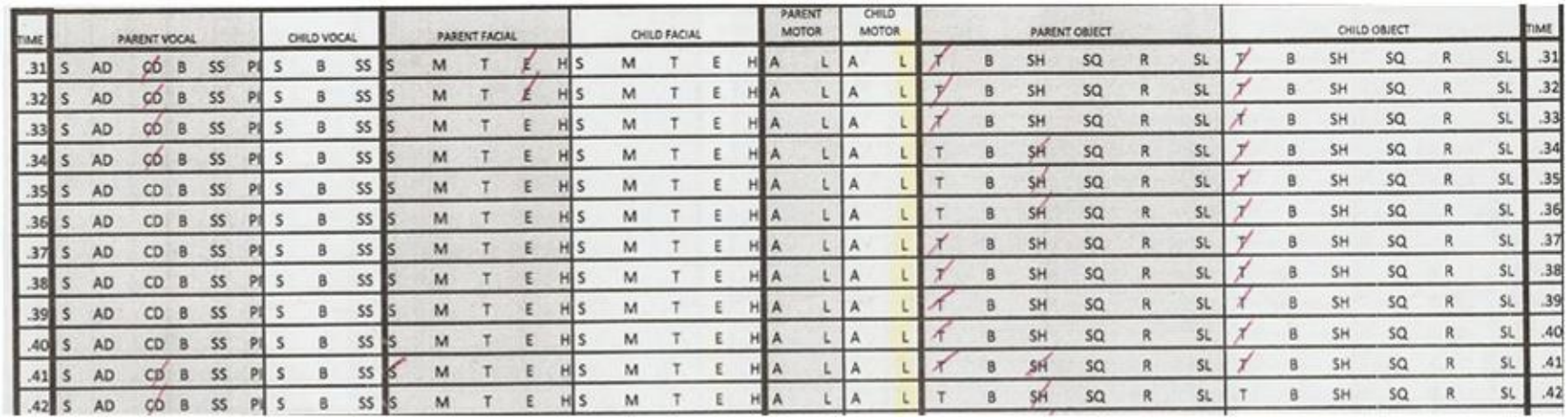
If the parent assists the child in any of the body movements, object manipulation, facial expressions, or vocalization (i.e. hand-over-hand the child to grasp an object, helps the child grasp their foot, hand-over-hand the child to give the parent a toy, or manipulates the child's mouth to make a vocalization) put an circle around the appropriate behavior in the child's behavior column for that second and for the duration of the prompt.
In this data set the mother smiles during second 1-2, the mother used her fingers to turn the corners of babies mouth up in a smile during second 3-5. The mother clapped her hands during second 6-8 and physically prompted the baby to clap during seconds 9-10

Scoring Object Manipulation

TIME	PARENT VOCAL	CHILD VOCAL	PARENT FACIAL	CHILD FACIAL	PARENT MOTOR	CHILD MOTOR	PARENT OBJECT	CHILD OBJECT	TIME
.01	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.01
.02	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.02
.03	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.03
.04	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.04
.05	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.05
.06	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.06
.07	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.07
.08	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.08
.09	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.09
.10	S AD CD B SS PI	S B SS	S M T E H	S M T E H	A L	A L	T B SH SQ R SL	T B SH SQ R SL	.10

If a parent engages in an object manipulation but the child never has the opportunity to manipulate the toy, mark the parent object manipulation with an “X”.
In this data set the mother banged a toy hammer on the floor, she then gave it to baby and baby banged the hammer on the floor. Mom took the hammer back and banged it again on the floor and then put it on the table where baby could not reach it.

Derived Data Example



TIME	PARENT VOCAL						CHILD VOCAL			PARENT FACIAL					CHILD FACIAL					PARENT MOTOR		CHILD MOTOR		PARENT OBJECT						CHILD OBJECT						TIME
.31	S	AD	CD	B	SS	PI	S	B	SS	S	M	T	E	H	S	M	T	E	H	A	L	A	L	T	B	SH	SQ	R	SL	T	B	SH	SQ	R	SL	.31
.32	S	AD	CD	B	SS	PI	S	B	SS	S	M	T	E	H	S	M	T	E	H	A	L	A	L	T	B	SH	SQ	R	SL	T	B	SH	SQ	R	SL	.32
.33	S	AD	CD	B	SS	PI	S	B	SS	S	M	T	E	H	S	M	T	E	H	A	L	A	L	T	B	SH	SQ	R	SL	T	B	SH	SQ	R	SL	.33
.34	S	AD	CD	B	SS	PI	S	B	SS	S	M	T	E	H	S	M	T	E	H	A	L	A	L	T	B	SH	SQ	R	SL	T	B	SH	SQ	R	SL	.34
.35	S	AD	CD	B	SS	PI	S	B	SS	S	M	T	E	H	S	M	T	E	H	A	L	A	L	T	B	SH	SQ	R	SL	T	B	SH	SQ	R	SL	.35
.36	S	AD	CD	B	SS	PI	S	B	SS	S	M	T	E	H	S	M	T	E	H	A	L	A	L	T	B	SH	SQ	R	SL	T	B	SH	SQ	R	SL	.36
.37	S	AD	CD	B	SS	PI	S	B	SS	S	M	T	E	H	S	M	T	E	H	A	L	A	L	T	B	SH	SQ	R	SL	T	B	SH	SQ	R	SL	.37
.38	S	AD	CD	B	SS	PI	S	B	SS	S	M	T	E	H	S	M	T	E	H	A	L	A	L	T	B	SH	SQ	R	SL	T	B	SH	SQ	R	SL	.38
.39	S	AD	CD	B	SS	PI	S	B	SS	S	M	T	E	H	S	M	T	E	H	A	L	A	L	T	B	SH	SQ	R	SL	T	B	SH	SQ	R	SL	.39
.40	S	AD	CD	B	SS	PI	S	B	SS	S	M	T	E	H	S	M	T	E	H	A	L	A	L	T	B	SH	SQ	R	SL	T	B	SH	SQ	R	SL	.40
.41	S	AD	CD	B	SS	PI	S	B	SS	S	M	T	E	H	S	M	T	E	H	A	L	A	L	T	B	SH	SQ	R	SL	T	B	SH	SQ	R	SL	.41
.42	S	AD	CD	B	SS	PI	S	B	SS	S	M	T	E	H	S	M	T	E	H	A	L	A	L	T	B	SH	SQ	R	SL	T	B	SH	SQ	R	SL	.42

For each second, or 3 seconds following the parent behavior, score the infant behavior in the correct category of the Derived Measures Data Sheet (Example Below). This data set yields the following derived data.

- Type Match
  - Touch Object-11
- Class Match
  - Touch Object-7
    - Matched with parent behavior Shaking Object-7
- Out Of Class Match
  - Touch Object-7
    - Matched with parent behavior Eye Movements-5
    - Matched with parent behavior Smile- 8
    - Matched with parent behavior Child Directed Talk-8

Derived Measures Data Sheet

Child:_____ Session:_____

VOCALIZATIONS	FACIAL MOVEMENTS	MOTOR MOVEMENT	OBJECT MANIPULATION
TYPE	TYPE	TYPE	TYPE
CLASS	CLASS	CLASS	CLASS
		N/A	
OUT OF CLASS	OUT OF CLASS	OUT OF CLASS	OUT OF CLASS
VOCAL PROMPTED	FACIAL PROMPTED	MOTOR PROMPTED	OBJECT PROMPTED

Vocal	Facial	Motor	Object	Total Type
Type _____/60	Type _____/60	Type _____/60	Type _____/60	
Class _____/60	Class _____/60	Class _____/60	Class _____/60	Total Class
Out of Class _____/60	Out of Class _____/60	Out of Class _____/60	Out of Class _____/60	Total Out of Class
Total Vocal Matches/ Min	Total Facial Matches/ Min	Total Motor Matches/ Min	Total Object Matches/ Min	

Calculations

$\frac{\text{\# of valid intervals}}{60} =$ number of minutes

$\frac{\text{\# of matches}}{\text{\# of minutes}} =$ Rate of matches per minute

APPENDIX K

ABBOTT'S RAW DATA

Abbott's Raw Data

			Vocalization			Facial Movements			Motor Movements		Object Manipulation		
Date	Session Number	Age in Weeks	Type Match	Class Match	Out of Class Match	Type Match	Class Match	Out of Class Match	Type Match	Out of Class Match	Type Match	Class Match	Out of Class Match
6/23/08	1	19	24	24	17	18	8	59	0	3	0	0	0
7/8/08	3	21	8	18	27	269	357	448	9	193	92	60	181
7/22/08	5	23	52	107	101	30	53	80	3	33	66	17	237
8/5/08	6	25	41	73	49	55	88	249	2	13	12	8	12
8/12/08	7	26	5	25	16	59	110	202	16	201	110	42	217
9/5/08	9	30	21	54	75	139	171	240	58	248	13	2	9
9/19/08	11	32	14	26	30	135	136	250	11	68	68	47	232
9/25/08	12	33	0	6	11	75	86	109	0	0	38	25	174

Abbott's Data in Rate Per Minute

			Vocal			Facial			Motor		Object		
Date	Session Number	Age in Weeks	Type Match	Class Match	Out of Class Match	Type Match	Class Match	Out of Class Match	Type Match	Out of Class Match	Type Match	Class Match	Out of Class Match
6/23/08	1	19	3.0	3.0	2.1	5.9	2.6	10.8	0.0	0.4	0.0	0.0	0.0
7/8/08	3	21	0.9	1.9	2.9	34.1	45.2	47.7	1.0	20.5	9.8	6.4	19.3
7/22/08	5	23	7.9	16.3	15.4	12.2	21.5	23.6	0.5	5.0	10.1	2.6	36.1
8/5/08	6	25	5.5	9.8	6.6	17.9	28.7	44.1	0.3	1.8	1.6	1.1	1.6
8/12/08	7	26	0.5	2.6	1.7	8.8	16.3	20.9	1.7	20.8	11.4	4.3	22.4
9/5/08	9	30	2.2	5.6	7.7	17.6	21.7	27.1	6.0	25.6	1.3	0.2	0.9
9/19/08	11	32	1.4	2.6	3.1	18.1	18.2	25.4	1.1	6.9	6.9	4.8	23.6
9/25/08	12	33	0.0	0.7	1.3	9.6	11.0	13.3	0.0	0.0	4.6	3.0	21.1

Abbott's Data in Rate Per Minute

Date	Session Number	Age in Weeks	Total Matches	Total Type Match	Total Class Match	Total Out of Class Match	Total Vocal Matches	Total Facial Matches	Total Motor Matches	Total Object Manipulation
6/23/08	1	19	27.90	8.96	5.66	13.28	8.2	19.3	0.4	0.0
7/8/08	3	21	189.45	45.65	53.49	90.32	5.6	126.9	21.5	35.4
7/22/08	5	23	151.10	30.59	40.37	80.14	39.6	57.3	5.5	48.7
8/5/08	6	25	119.02	25.35	39.62	54.05	22.0	90.7	2.0	4.3
8/12/08	7	26	111.23	22.29	23.26	65.68	4.8	46.0	22.4	38.1
9/5/08	9	30	115.93	27.12	27.46	61.35	15.5	66.4	31.5	2.5
9/19/08	11	32	112.16	27.54	25.64	58.98	7.1	61.7	8.0	35.3
9/25/08	12	33	64.75	14.19	14.74	35.82	2.1	33.9	0.0	28.8

Abbott's Total Number of Valid Minutes

Date of Session	Session Number	Age in Weeks	Vocal			Facial			Motor		Object		
			Type Match	Class Match	Out of Class Match	Type Match	Class Match	Out of Class Match	Type Match	Out of Class Match	Type Match	Class Match	Out of Class Match
6/23/08	1	19	7.9	7.9	7.9	3.0	3.0	5.5	7.9	7.9	7.9	7.9	7.9
7/8/08	3	21	9.4	9.4	9.4	7.9	7.9	9.4	9.4	9.4	9.4	9.4	9.4
7/22/08	5	23	6.6	6.6	6.6	2.5	2.5	3.4	6.6	6.6	6.6	6.6	6.6
8/5/08	6	25	7.4	7.4	7.4	3.1	3.1	5.7	7.4	7.4	7.4	7.4	7.4
8/12/08	7	26	9.7	9.7	9.7	6.7	6.7	9.7	9.7	9.7	9.7	9.7	9.7
9/5/08	9	30	9.7	9.7	9.7	7.9	7.9	8.9	9.7	9.7	9.7	9.7	9.7
9/19/08	11	32	9.8	9.8	9.8	7.5	7.5	9.8	9.8	9.8	9.8	9.8	9.8
9/25/08	12	33	8.2	8.2	8.2	7.8	7.8	8.2	8.2	8.2	8.2	8.2	8.2

Abbotts Total Number of Valid Intervals

Date of Session	Session Number	Age in Weeks	Vocal			Facial			Motor		Object		
			Type Match	Class Match	Out of Class Match	Type Match	Class Match	Out of Class Match	Type Match	Out of Class Match	Type Match	Class Match	Out of Class Match
6/23/08	1	19	476	476	476	182	182	329	476	476	476	476	476
7/8/08	3	21	564	564	564	474	474	564	564	564	564	564	564
7/22/08	5	23	394	394	394	148	148	203	394	394	394	394	394
8/5/08	6	25	445	445	445	184	184	339	445	445	445	445	445
8/12/08	7	26	581	581	581	404	404	581	581	581	581	581	581
9/5/08	9	30	582	582	582	473	473	531	582	582	582	582	582
9/19/08	11	32	590	590	590	448	448	590	590	590	590	590	590
9/25/08	12	33	494	494	494	470	470	490	494	494	494	494	494

APPENDIX L

LUCY'S RAW DATA

Lucy's Raw Data

			Vocal			Facial			Motor		Object		
Date of Session	Session Number	Age in Weeks	Type Match	Class Match	Out of Class Match	Type Match	Class Match	Out of Class Match	Type Match	Out of Class Match	Type Match	Class Match	Out of Class Match
07/01/08	1	5	14	17	6	37	47	175	0	118	0	0	0
07/15/08	2	7	21	39	37	178	240	456	0	76	0	0	0
07/22/08	3	8	13	45	48	181	238	378	31	278	0	0	0
08/05/08	4	10	21	40	41	121	277	395	0	151	5	0	19
08/12/08	5	11	23	29	44	177	292	348	2	76	0	0	0
08/26/08	7	13	43	81	84	215	322	422	4	212	0	0	0
09/02/08	8	14	51	62	87	593	713	733	6	187	0	0	0
09/09/08	9	15	13	49	52	95	134	287	2	111	72	39	86
09/16/08	10	16	34	62	76	139	308	305	0	116	56	4	151
09/23/08	11	17	11	15	25	140	227	346	0	60	133	51	129
09/30/08	12	18	12	58	49	115	192	222	17	197	35	4	65

Lucy's Data in Rate Per Minute

			Vocal			Facial			Motor		Object		
Date of Session	Session Number	Age in Weeks	Type Match	Class Match	Out of Class Match	Type Match	Class Match	Out of Class Match	Type Match	Out of Class Match	Type Match	Class Match	Out of Class Match
07/01/08	1	5	1.4	1.7	0.6	15.5	19.7	19.0	0.0	12.0	0.0	0.0	0.0
07/15/08	2	7	2.1	3.9	3.7	34.8	46.9	80.5	0.0	7.7	0.0	0.0	0.0
07/22/08	3	8	1.3	4.5	4.8	44.3	58.3	42.3	3.1	27.8	0.0	0.0	0.0
08/05/08	4	10	2.2	4.2	4.3	23.7	54.3	41.1	0.0	15.7	0.5	0.0	2.0
08/12/08	5	11	2.3	2.9	4.5	32.6	53.7	47.8	0.2	7.7	0.0	0.0	0.0
08/26/08	7	13	4.4	8.2	8.5	31.2	46.7	46.0	0.4	21.5	0.0	0.0	0.0
09/02/08	8	14	5.2	6.3	8.8	65.4	78.6	76.8	0.6	18.9	0.0	0.0	0.0
09/09/08	9	15	1.3	5.0	5.3	25.9	36.5	32.6	0.2	11.4	7.4	4.0	8.8
09/16/08	10	16	3.5	6.3	7.7	14.7	32.5	31.5	0.0	11.8	5.7	0.4	15.4
09/23/08	11	17	1.1	1.5	2.5	35.0	56.8	38.6	0.0	6.1	13.4	5.1	13.0
09/30/08	12	18	1.3	6.4	5.4	24.9	41.6	44.5	1.9	21.7	3.9	0.4	7.2

Date of Session	Session Number	Age in Weeks	Total Matches	Total Type Matches	Total Class Matches	Total Out of Class	Total Vocal Matches	Total Facial Matches	Total Motor Matches	Total Object Manipulation
07/01/08	1	5	70.00	16.95	21.45	31.61	3.8	54.3	12.0	0.0
07/15/08	2	7	179.66	36.91	50.85	91.89	9.8	162.2	7.7	0.0
07/22/08	3	8	186.43	48.73	62.79	74.91	10.6	144.9	30.9	0.0
08/05/08	4	10	147.99	26.43	58.47	63.09	10.6	119.2	15.7	2.5
08/12/08	5	11	151.73	35.11	56.68	59.94	9.7	134.1	7.9	0.0
08/26/08	7	13	166.76	35.91	54.86	75.99	21.0	123.9	21.9	0.0
09/02/08	8	14	260.50	71.16	84.90	104.43	20.2	220.8	19.5	0.0
09/09/08	9	15	138.49	34.83	45.57	58.09	11.7	95.0	11.6	20.2
09/16/08	10	16	129.46	23.83	39.20	66.44	17.5	78.6	11.8	21.5
09/23/08	11	17	173.09	49.52	63.41	60.17	5.1	130.3	6.1	31.6
09/30/08	12	18	159.25	31.97	48.43	78.85	13.1	111.0	23.6	11.5

Lucy's Valid Intervals

Date of Session	Session Number	Age in Weeks	Vocal			Facial			Motor		Object		
			Type Match	Class Match	Out of Class Match	Type Match	Class Match	Out of Class Match	Type Match	Out of Class Match	Type Match	Class Match	Out of Class Match
07/01/08	1	5	591	591	591	143	143	552	591	591	591	591	591
07/15/08	2	7	593	593	593	307	307	340	594	594	594	594	594
07/22/08	3	8	600	600	600	245	245	536	600	600	600	600	600
08/05/08	4	10	577	577	577	306	306	576	577	577	577	577	577
08/12/08	5	11	592	592	592	326	326	437	592	592	592	592	592
08/26/08	7	13	593	593	593	414	414	550	593	593	593	593	593
09/02/08	8	14	594	594	594	544	544	573	594	594	594	594	594
09/09/08	9	15	585	585	585	220	220	529	585	585	585	585	585
09/16/08	10	16	589	589	589	569	569	581	589	589	589	589	589
09/23/08	11	17	595	595	595	240	240	538	595	595	595	595	595
09/30/08	12	18	544	544	544	277	277	299	544	544	544	544	544

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