

# University of Alberta

An examination of parent-child dyadic interaction and the impact of a parent-training program designed to support the language development of toddlers diagnosed with autism spectrum disorder (ASD)

by

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## Abstract

Parents can effectively facilitate positive child behaviour change (Kaiser & Hancock, 2003). Their inclusion as interventionists is an essential component of autism intervention (NRC, 2001) and represents a natural step toward consistent early intervention. However, what constitutes effective delivery of parent programs and their effect outside research settings is limited. The present study explored patterns of change in parent-child communication in the child's natural language learning environment after participation in Hanen's *More Than Words* program. Four patterns of change in the quality and quantity of parent-child talk and language were observed. Overall, parents increased talk immediately after intervention but failed to maintain the increase. Children demonstrated significant changes in gestures, receptive language and frequency of coordinated joint attention.

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## Introduction

Language and communication skills are important predictors of long-term outcomes for children with Autism Spectrum Disorder (ASD) (Stone & Yoder, 2001), thereby making them a priority for families and service professionals. However, the process of communication development for children with ASD is more variable in timing and in functional outcomes than for typically developing children, such that intervention is required (Siller & Sigman, 2002). For example, young children with ASD often remain in the pre-linguistic stage for a longer period of time than typically developing children (Wetherby, 2006) and consequently demonstrate delays in verbal development (Smith, Mirenda, & Zaidman-Zait, 2007). Prior to verbal language development, parents are instrumental at initiating and responding to bids for joint attention with their children (Schertz & Odom, 2007) and parent-child interaction has been demonstrated to impact later child language outcomes (Yoder & Warren, 1999). Including parents as interventionists for children whose preverbal skills are compromised is a natural step in providing consistent, daily intervention throughout childhood and is considered to be an essential factor in autism intervention (National Research Council, 2001). Preliminary evidence suggests that via parent training programs, parents can become effective facilitators of the language development of children with ASD (Kaiser & Hancock, 2003). However, less is known about the essential components of parent training, what constitutes effective delivery of a parent program and to what degree parents can accurately implement intervention across changing environments and over time.

### *Parent-Child Interaction*

A transactional model of development (Sameroff & Chandler, 2010) emphasizes the significance of reciprocal and bidirectional exchanges between child and environment as the context for early learning. In this model, central to a child's developmental outcome is an iterative and ongoing process that combines two parallel components: (1) biological and environmental factors and (2) child behaviours. Sameroff and MacKenzie (2003) state that a child's characteristics are not innately stable but can become constant when reinforced by consistent social experiences in the child's environment. Thus, the daily, natural social and communicative interactions that take place between a child and his or her family can shape both the child's traits as well as the parents' characteristics. The practical importance of the transactional model of development is supported by the directional change of intervention practices toward a family centered model of care where parents are considered respected partners and facilitators of intervention supports for their children with ASD and a move away from a solely clinician directed model of intervention (Brookman-Frazee, 2004).

Parent responsivity and interactivity are seen as critically important in the child's development of preverbal communication skills, specifically joint attention abilities which have been identified as predictors of early language development (Mundy & Crowson, 1997; Sigman & Ruskin, 1999). Joint attention skills involve the coordination of attention between two individuals and an object or activity and have been found to be foundational for not only language skills but also skills in the social and academic domains (Mundy & Crowson, 1997). For children with

ASD, the development of joint attention skills is fundamentally impaired (Charman et al., 2003) and is associated with slower progress developing expressive language (Smith et al., 2007). These delays can hinder the number of high quality opportunities for communicative interaction open to a child with ASD (Kaiser, Hester & McDuffie, 2001; Siller & Sigman, 2002). Due to the potential disturbances in the development of communicative interactions of children with ASD, the interactions that do take place are of even greater importance (El-Ghoroury & Romanczyk, 1999). Parents of young children with ASD are therefore of critical importance, they interact most frequently with their children and the ways in which they engage in these interactions has been demonstrated to affect the development of their children's language and communicative skills (Kaiser et al., 2001; Siller & Sigman, 2002).

Empirical examination of the impact of parents' talk and interaction with their child is a developing area of study within the ASD population but has been examined over the past twenty years amongst families of typically developing children (e.g. Bakeman & Adamson, 1984; Hart & Risley, 1995; Sigman & Ruskin, 1999). This body of literature has collectively demonstrated that the style in which parents engage with their child and the frequency of this interaction can impact a child's language development (Siller & Sigman, 2002). Congruent with a transactional model of development, social interactions with others can provide important language learning opportunities and the context for language development (Siller & Sigman, 2002). For example, a parent's ability to engage his or her child in periods of joint engagement and then maintain this state of

engagement has been reported to predict a child's language growth (Siller & Sigman, 2002).

A large amount of variability has been found amongst families of typically developing children in terms of the amount that parents talk and interact with their children (Gilkerson & Richards, 2008). Scientific members of the Language Environmental Analysis (LENA) Foundation have conducted a study examining parent-child talk frequency amongst 329 families of typically developing American toddlers (age 2 months to 48 months) in order to obtain normative frequency counts for the digital language processor (DLP). Caregivers in the study produced a range of hourly adult talk per 12 hour recording used to develop percentile norms (e.g. 500.25 words per hour at the 10<sup>th</sup> percentile to 2452.33 words per hour at the 99<sup>th</sup> percentile) (Gilkerson & Richards, 2008). This finding has recently been extended to families of young children diagnosed with ASD (Warren et al., 2009). Warren et al (2009) found that families of toddlers with ASD spoke at rates roughly similar to that of families of typically developing children in the normative study. However, other research specifically examining parent-child interaction within families with children diagnosed with ASD have demonstrated differences in both the style and frequency of parent-child interaction compared to families of typically developing children as well as children with intellectual disability (Wilder, Axelsson & Granlund, 2004). Still other research has suggested that parents of children with ASD have been reported to engage in a lesser number of interactions with their child (Konstantareas & Homatidis, 1992).

It has been suggested that some of the variability in talk frequency across families of toddlers is linked to parent characteristics such as parent education and socio economic status (Hart & Risley, 1995). Hart and Risley (1995) reported parents of typically developing toddlers who had achieved college level education spoke at rates more than three times greater than families receiving welfare assistance and double the rate of working class families. However, specific parent factors or characteristics that may help or hinder a child's language development in the ASD population as a whole have not yet been thoroughly explored (Kasari, 2002; Lord et al., 2005).

#### *Capturing Parent-Child Interactions*

With the advent of video recording, multiple studies have moved away from artificial lab based sampling of parent-child interaction data (El-Ghoroury & Romanczyk, 1999; Koegel, Bimbela & Schreibman, 1996; Pino, 1999; Ruble, McDuffie, King & Lorenz, 2008). Coding schemes, such as those developed by Bakeman and Adamson (1984) have been used to examine the frequency of various forms of coordinated and uncoordinated engagement in dyadic interaction in families of typically developing children. These methods are advantageous because they can capture the *quality* of parent-child interaction in more natural settings, such as the home environment. However, video recording methods can be intrusive, interrupting the natural flow of the family routine and provide researchers with only a tiny snapshot of the many interactions that occur across the family's day. In order to obtain child communicative data in the child's natural environment and lessen the confounding factors presented by artificial

laboratory situations, researchers are beginning to utilize audio capture devices such as digital language processors (DLPs) that have been designed for use in unstructured environments (Gilkerson & Richards, 2008). As such, this form of direct data capture holds the promise of allowing both the collection and examination of data in the child's natural environment which may provide insights into the nature and potential changes in the *quantity* of parent-child communicative interactions. One such device, the Language Environment Analysis (LENA) DLP, is placed on the child (e.g. pocket of clothing) and records up to 16 hours of audio data in the child's natural environment, removing the constraints of an artificial laboratory setting. The data can later be analyzed at multiple levels of intensity using several computer software programs to determine for example, frequency counts of components of interaction including adult word count, conversational turns and child vocalization frequency (Gilkerson & Richards, 2008). Although the use of DLPs is recent, the reliability and validity of the LENA DLP has been tested quite extensively, demonstrating both high reliability and validity (Xu, Yapanel & Gray, 2008). By using the DLP, researchers have the ability to get a picture of the child's communicative environment and interactions across an entire day, a valuable supplement to video data.

### *Parent Education and Training Programs Targeting the Language Development of Young Children with ASD*

The identification and diagnosis of ASD in toddlers and young children is leading to increasing numbers of very young children requiring intervention

services (Vismara, Colombi & Rogers, 2009). To date, the body of autism intervention literature contains relatively few studies examining interventions specifically for infants and toddlers diagnosed with ASD (for exceptions see: Dawson et al., 2010, Vismara et al., 2009). Providing young children diagnosed with ASD with at least 25 hours of intensive intervention per week is considered best practice (NRC, 2001). However, providing the human and financial resources necessary to provide each child with such intensive supports is not always feasible. Parent-training programs, seen by some as an adjunct to intensive one to one services and by others as an alternative more developmentally appropriate service for infants and toddlers, offer families a method by which they can provide ongoing and consistent intervention through the daily interactions they already participate in with their child (McConachie & Diggle, 2007). Parent education and training programs involve the “process of providing parents and other primary caregivers with specific knowledge and childrearing skills with the goal of promoting the development and competence of their children” (Mahoney et al., 1999, pg. 131). Through parent-training programs, parents have the opportunity to observe their child’s ability to learn and to obtain an understanding of the direct role they can play in facilitating their child’s growth and development (Dawson et al., 2010). Recent reviews of parent-training programs for children with ASD have demonstrated preliminary evidence supporting their efficacy (e.g., Lang, Machalicek, Rispoli & Regester, 2009; Matson, Mahan & Matson, 2009; Meadan, Ostrosky, Zaghawan & Yu, 2009). Parent-training programs for families of children with ASD arise from a variety of theoretical

foundations including applied behaviour analysis (e.g. Koegel, Koegel, Harrower & Carter, 1999), social interactionist theory (e.g. Girolametto et al., 2006) and mixed theory programs (e.g. Vismara et al., 2009). Manualized parent programs are fewer in quantity than eclectic programs that are composed of components of a variety of popular programs (e.g. Aldred, Green & Adams, 2004; Ingersoll, Dvortcsak, Whalen & Sikora, 2005). Overall, the implementation of parent education programs has been shown to impact both parent behaviours and child behaviours (Stahmer & Gist, 2001). For example, evaluations of parents' behaviours have indicated decreased parent stress (Moes, 1995), increased maternal understanding of ASD (McConachie & Diggle, 2007) and positive parent affect (Koegel, Bimbela & Schreibman, 1996). Further, in terms of child behaviour, increased communication skills (Drew et al., 2002; McConachie & Diggle, 2007; Stahmer & Gist, 2001), increased vocabulary (Girolametto, Sussman & Weitzman, 2006; McConachie, Randle, Hammal, & Le Couteur, 2005) increased engagement (Girolametto et al., 2006), initiations of social interaction (Girolametto et al., 2006), increases in imitative behaviours (Ingersoll & Gergans, 2006) and increases in the generalization and maintenance of treatment gains obtained in one to one treatment (Koegel, Glahn & Nieminen, 1978), have been reported.

#### *The Hanen More Than Words Program*

The Hanen *More Than Words* (MTW) program is a widely used manualized parent education program designed to support parents' in their growing ability to facilitate their child's language development (Sussman, 1999).

The MTW program was developed based on social interactionist theory (Sussman, 1999) which emphasizes the use of the naturalistic, daily interactions and activities that take place between the child and parent as the context for language learning (Girolametto et al., 2006). Parents and other caregivers are taught to be “responsive” to their child’s communicative attempts and to interpret the child’s attempts as meaningful communication (Girolametto et al., 2006).

The MTW program was developed to fit the unique needs of families with young children diagnosed with ASD from the earlier Hanen *It Takes Two To Talk* program designed for children with speech and language delays (Sussman, 1999). The program includes eight 2.5 hour group parent training sessions and three individual in home video feedback sessions (Girolametto et al., 2006). All sessions are conducted by a Hanen certified speech language pathologist and take place across eight to eleven weeks. The program has three objectives in order to facilitate parents’ effective use of the natural language learning opportunities they engage in with their child: 1) to educate parents about their child’s learning style and basic communication concepts, 2) to teach parents to implement early communication and language intervention and, 3) provide social support for parents (Sussman, 2006). In order to obtain these goals, parents are taught three different sets of strategies in MTW (Sussman, 2006). The first set of strategies contain “child-oriented” strategies that target skills including following the child’s lead, observing the child, waiting and listening. The next cluster includes “interaction-prompting” strategies that focus on using routines to encourage turn taking, appropriately prompting turns and intruding into a child’s activity to create

language opportunities (Sussman, 2006). Finally, parents are taught “language-modeling” strategies where they are shown how to interpret their child’s communicative attempts as meaningful bids for interaction, to simplify their language, emphasize important words, use visual aids and expand communication (Sussman, 2006).

Although earlier Hanen programs such as the *Hanen Parent Program* and *It Takes Two to Talk* have undergone some empirical evaluation, research is limited for the MTW program which has been evaluated in only two published studies (Girolametto et al., 2006; McConachie, Randle, Hammal & Le Couteur, 2005). These two studies have demonstrated positive preliminary effects for both parent and child behaviours after delivery of the MTW program. For example, Girolametto and colleagues (2006) demonstrated that the three children in their multiple case study increased their engagement in social interactions and rate of communicative acts while mothers increased their responsiveness to their children’s communicative interactions. McConachie and colleagues (2005) reported that parents demonstrated changes in their behaviour including increased positive affect and strategy usage compared to a control group. Further, the children of parents who attended MTW showed larger increases in their vocabulary than children of parents who did not attend MTW. What is missing from these studies is an evaluation and understanding of parents’ mastery and use of the MTW strategies in their daily lives and the maintenance of these skills over time.

*Parent Learning and Fidelity of Implementation: Maintenance and Generalization*

The delivery of parent-training and education programs to increase effective communicative interactions between parents and their young children who have ASD has become a recommended clinical practice (NRC, 2001) and represents another step in a progression toward family centered practices (Crocket, Fleming, Doepke, & Stevens, 2007). The benefits in terms of intensity of intervention for children with ASD, advantageous utilization of therapeutic and monetary resources as well as the potential for treatment gains supports parent training as a necessary and untapped resource (Matson, Mahan & Matson, 2009). However, research examining parents' mastery of the skills and strategies presented in the program and their maintenance of these strategies over time is lagging behind (Patterson, Smith & Mirenda, under review). The advent of new technology (e.g., the LENA DLP) opens the door for researchers to engage in explorations of these concepts in the child's natural language learning environment, lessening the confounds created by contrived laboratory scenarios, and allowing the research community to have the ability to obtain a larger picture of natural parent-child communicative interactions that we have been unable to access in the past.

Further, what is missing from the evidence base for parent-training programs is an often overlooked aspect of evidence, practice-based evidence (McCall, 2009). Practice-based evidence addresses issues related to the real-world complexities of replicating evidence-based programs. The present study will take

place in a community setting and will contribute to the practice-based evidence for parent-training programs in language development. Evaluations of parent-training programs such as MTW have the potential to tell us not only about the efficacy of specific parent programs but also about the dynamic nature of a young child's natural language learning environment as well as the environmental characteristics that may support or hinder child language development.

Therefore, for the purpose of this study, the author seeks to examine the following questions: (1) what is the base frequency of communicative interaction between toddlers with ASD and their parent(s)?, (2) which components of the MTW program do parents learn to master?, and (3) to what degree does the parent education program (*Hanen More Than Words*) influence the nature and frequency of communicative interactions among toddlers with ASD and their parents?

## Methods

### *Participants*

*Inclusion.* A convenience sample of two cohorts of families with toddlers diagnosed with ASD were included in this study. Toddlers were enrolled in an infant and toddler intervention program through a local Edmonton service provider. Study information was provided to all families enrolled in the program. Families included in the study: (a) had a child who was no older than 40 months at the beginning of the study; (b) agreed to participate in the *More Than Words* parent program through their intervention provider; and (c) agreed to collection of in home audio data.

*Participant characteristics.* The participants were recruited from two cohorts of families participating in a pilot infant/toddler intervention program through a local service provider in the Edmonton area. The first cohort included seven families enrolled in spring 2009 and the second included five families enrolled in fall 2009. Across the twelve families, children ranged in age from 28-39 months (mean: 33 months) with a developmental age of 2-22 months (mean: 9 months). Of the twelve children, eight were male and four were female. All children were diagnosed by an independent clinical assessment team. Eleven children were diagnosed with autism, while one child was diagnosed with global developmental delays where autism was being queried (child 5). It should be noted that Child 2's initial diagnosis of autism was changed to Rett's syndrome by first follow up. Two children also had co-morbid diagnoses including seizure disorder (child 4), pica (child 3) and a sensory processing disorder (child 3). Child 4 was receiving medication to control the occurrence of seizures.

All twelve families were comprised of two parents (mother and father) with the exception of child 1 where a grandmother served as the second primary caregiver. The primary caregiver was the mother in eleven families while the father was the primary caregiver for child 11. In the case of child 8, a nanny also served as a primary caregiver and also attended the MTW program. The mothers' age ranged from 21 to 42 years of age (mean: 35.3 years). Mothers (n=12) had achieved a range of levels of education including some high school (n=2), diploma/certificate (n=3), some university (n=1), undergraduate degree (n=4), master's degree (n=1) and a medical degree (n=1). Fathers (n=11) ranged in age

from 36 to 46 years of age (mean: 38.1 years). Fathers' education level varied including high school diploma (n=3), diploma/certificate (n=5), undergraduate degree (n=1) and master's degree (n=1). Further, 10 children had a sibling in their home. In the case of child 7, the sibling was also diagnosed with ASD. Eight of the twelve families used English as the primary language in the home while two spoke both English and a second language (including Amharic, French, Urdu and Tagalog). Three families identified themselves as Asian and two as African Canadian while the other seven identified themselves as Caucasian. Participant characteristics for all 12 families are reported in Table 1.

*Attrition.* In total, 12 families participated in this study. All eight families in the first cohort consented to participate in the study however, one family was required to relocate before the start of the baseline measures and thus, seven families enrolled and completed all four measures in the study. Five of seven families in the second cohort agreed to participate in the study with four completing all four sets of measures. The fifth family chose to decline participation in follow up measures.

### *Setting*

*Parent-child interaction.* Audio data was collected in the families' homes. Families were asked to indicate who was present with the child during the day and if, for the child's safety, the DLP was removed and set beside the child during activities such as bathing, car rides or sleeping.

*Intervention.* The MTW program was delivered twice, once to cohort one and once to cohort two. The eight group sessions were conducted in a boardroom

at the head office of the service provider on a weekday evening. Session 8 was delivered four weeks after session 7 for the first cohort of families (n=7) due the presence of a contagious illness in the Edmonton area. Childcare was provided on site by staff and volunteers familiar with the children.

### *Experimental Design and Intervention Procedure*

This study employed an interrupted time-series design to obtain data on the frequency of parent-child interaction and child language development at four different points in time: before participation in the MTW program, mid way through MTW (between weeks four and five), immediately post participation in MTW and at two month follow up. A second follow up measure was collected from the first cohort of families (n=7) nine months after participation in the MTW program. This second measure will also be conducted with the second cohort of families once they are nine months post intervention (Fall 2010).

*Intervention.* At least one parent/caregiver of each child attended the eight 2.5 hour group MTW parent education sessions, one evening per week for eight weeks (see table 2 for description of group sessions). For child 1 and child 8, additional caregivers (e.g. nanny, grandmother) also attended the MTW sessions as they were also considered primary caregivers. Two Hanen certified speech language pathologists (SLP) conducted the group sessions. The first cohort received the program in seven consecutive weeks with the eighth session delivered four weeks after session seven as previously mentioned (May-June 2009). The second cohort began the MTW program in November 2009 completing four consecutive weeks, followed by a two-week hiatus for the

holidays and then the completion of the final four weeks of the program in January 2010. The senior SLP provided the majority of the content as well as the majority of the in home feedback for both cohorts. The junior SLP relocated half way through the second cohorts' MTW program. At this point, all families received all MTW related services from the senior SLP. Families participated in three in home video feedback sessions as part of the MTW program at the following intervals: (1) before the start of the MTW program, (2) in the week following session 2, and (3) in the week following session 7. These three sessions were intended to provide the family with one on one individualized coaching to target goals within an activity (e.g. playing a game, reading a book) identified as a priority by the family at the group session. The SLP then assisted the family in correctly utilizing the strategies presented in the MTW program in the routine they identified.

### *Measures*

*Program completion record.* Attendance was recorded by the researchers at each of the eight MTW group sessions as well as the three in home sessions. Parent and caregiver attendance was collected separately for group and home session attendance as well as a percentage for total participation referred to as “dosage” (number of in home and group session attended/ 11 sessions).

*Demographic form.* Families were asked to complete a demographic information form to describe child characteristics including birth date, diagnosis, ethnicity, time of diagnosis, co-morbid diagnoses and medication usage as well as parent characteristics such as birth date, ethnicity, level of education and first

language. Further, parents were asked to provide the same information for any other primary caregivers who live in the home (e.g. nanny, grandparent). Last, parents also reported family characteristics such as language spoken in the home, number of siblings and age of siblings.

*MacArthur Communicative Development Inventory (MCDI): Words and Gestures.* The MCDI is a parent report questionnaire about child language development that was completed by a primary caregiver in each family at each of the four time points. The MCDI requires parents to report the child's receptive vocabulary, expressive vocabulary and gesture usage (Fenson et al., 2007). In the case where multiple DLP recording sessions were taken at one of the four time points (e.g. baseline), the questionnaires were completed during the first day's measure. The MCDI has undergone various independent examinations testing its validity. The MCDI has been found to provide results similar to those found by direct clinician observations and is useful to obtain an assessment of a child's functional language level (Luyster, Lopez & Lord, 2007).

The MCDI questionnaire was utilized to obtain counts for the following child language outcomes: (a) child receptive vocabulary: the number of parent reported words that the child understands, (b) child expressive vocabulary: the number of parent reported words that a child uses verbally, and (c) child gestures: the number of parent reported non verbal communicative gestures that a child uses to communicate. The MCDI was used to evaluate the language age of the children as well as to obtain an understanding of the child's language development over the course of the MTW program. MCDI gestures were broken

into early gestures (18 items including items such as pointing and showing objects) and later gestures (45 items including gestures such as imitating adult actions and games/routines) (Fenson et al., 2007) for analysis. MCDI data was examined for correlations with parent skill mastery and talk frequency.

*LENA digital language processor (DLP)*. The DLP was used to obtain in home parent and child communication frequencies. The DLP and the LENA child clothing were dropped off in the morning at the family's home and picked up at the end of the day by a member of the research team for each measure. When the child awoke, the parent dressed the child in the piece of LENA clothing (vest or overalls) provided for them, placing the DLP in the front pocket. For the child's safety, the families were asked to take off the clothing and place the DLP in a safe location near the child if: (a) the child napped, (b) the child bathed or (c) the child was riding in the car. The families were asked to keep the DLP recording at all times and to not turn the device off at any point during the day. As such, in order to uphold the parents' privacy in personal family communications the families were given the opportunity to instruct the researchers to not listen to sections of the audio data. Although the DLP system is relatively new technology, the device and its software have been tested and demonstrate both high validity and reliability (Xu et al., 2008).

The DLP was utilized to obtain frequency counts for the following four outcome measures: (a) adult communication frequency: the number of adult words produced in the home in a 6 foot range of the child, (b) conversational turn frequency: the occurrence of an adult word segment and a child vocalization

segment separated by no other live human speaker segment, (c) child vocalizations: number of non-vegetative sounds produced by the child and (d) child initiations: number of interactions with an adult male or female started by the child.

*Videotape.* Videotape footage was taken by the SLP conducting the MTW program at the three in home video feed back sessions. The clips capture the primary caretaker(s) engaging in a family routine or activity with their child (including people games, toys and books) designed to target the use of one more of the MTW strategies. The video segments were coded by two independent reviewers using published criteria by Bakeman and Adamson (1984) designed to evaluate parent-child engagement states. Six engagement states are described by Bakeman and Adamson (1984) including: (1) unengaged: the child is not engaged with any person, object or activity, (2) onlooking: the child observes an activity but does not take an active role in it, (3) persons engagement: the child is involved with only the other person even if objects or activities are present, (4) object engagement: the child is engaged with only an object even if another person is present in the activity, (5) passive joint engagement: the child is involved in the same activity with the parent but shows little acknowledgement of the parent's involvement and (6) coordinated joint engagement: the child actively coordinates his or her attention between the parent and the object they are engaged with. Three additional codes are included to describe states when the child is not engaged in any of the above: (1) off camera: the child is out of the view of the camera, (2) adult intervention: the child becomes upset to the point where the

adult intervenes to comfort the child and (3) adult interruption: the parent impedes the child's activity or behaviour because he or she is concerned about the nature of the activity or behaviour. Videos were coded to identify: 1) the predominant child engagement state during the activity and 2) the frequency of each of six engagement states noted by Bakeman and Adamson (1984). Video data was examined both within and across participants. Within subject video data was examined for change in the frequency of the various engagement states as the parents progressed through the MTW program. Families who participated in less than two in home video feedback sessions were not included in the analysis because change scores could not be calculated (family 1 and 9). Inter-rater reliability was calculated for all activities (including toys, books, people games and song), at each phase of the study. Overall, inter-rater reliability was 90.23%.

*Clinician evaluation and parent self-rating questionnaires:* At follow up, the SLP who conducted the MTW program was asked to rate parents' skills both before and after their participation in MTW using a questionnaire (see appendix A). The scale is comprised of 24 items separated into five categories: 1) Stage of communication and objective (e.g. ability to identify an appropriate goal for their child), 2) Skills (e.g. use of MTW strategies such as imitation and expansion), 3) Activities (e.g. the ability to engage in a people game or toy with the child), 4) Implementation fidelity (e.g. the caregivers' overall ability to accurately implement the skills and strategies), 5) Generalization (e.g. the ability to utilize opportunities for language learning using the MTW strategies across routines and activities) and 6) Maintenance (e.g. the ability to use the skills over time). These

items were designed to allow the clinician to rate the parents' mastery of the skills and strategies presented in MTW using a seven point scale where a score of 1 indicates the parent almost never uses the strategy or skill and a score of 7 indicates the parent consistently uses the skill or strategy correctly. The clinician provided a score for each item for each primary caregiver to represent the individual's skills at the start of MTW as well a score to represent their skills at the end of the program. See table 3 for a breakdown of the rating criteria.

Parents and other caregivers evaluated their skill using the same questionnaire, however, the items were worded differently to suit an audience comprised of parents (see appendix B). In the same fashion as the clinician, parents were asked to provide a 1 to 7 rating of their skills before and after MTW. The clinician evaluations were compared with the parents' self-evaluations for similarities and discrepancies. The clinician evaluations were examined across participants for emerging descriptive patterns of adult mastery of MTW strategies and skills.

### Data Analysis

The DLP data were examined to obtain hourly frequency counts for: 1) adult words (AW), conversational turns (CT) and child vocalizations (CV) per 10-12 hour family recording. As several recordings were collected at baseline, family AW, CT and CV were averaged to obtain a mean. Two pieces of data were used to examine parent skill development: a) clinician evaluation of parent skill mastery, and b) parent self-evaluation. The magnitude of change on individual items on parent and clinician ratings between baseline and post measures was

calculated. Additionally, parent and clinician ratings were examined for discrepancies. Changes in child, adult language DLP data were calculated and plotted graphically across the four time points. The DLP data were examined for differences in the frequency of AW between time points using paired sample t-tests. Measures of effect size (Cohen's d) were also calculated for significant t-tests. Parent-child interaction video recordings at three time points were coded at 10 second intervals for child engagement states (Bakeman & Adamson, 1984). Coded videos were examined for changes in the child's state of engagement across time points. The video child engagement data were examined for differences in each of the six child engagement states pre and post intervention using paired sample t-tests and a measure of effect size (Cohen's d). Similarly, changes in child MCDI scores (expressive, receptive language and gestures) were examined using paired sample t-tests and a measure of effect size (Cohen's d). Correlations between changes in child language (including MCDI scores, DLP child vocalizations, video child initiation, video child engagement states) and adult talk variables from pre to post test were calculated to determine the strength of the relationship between variables.

## Results

### *Parent Participation*

Participation and attendance in the group and at home sessions varied across the families (see Table 4 for a summary). Two parents or caregivers participated in the MTW group sessions for the majority of families (n=10). Three caregivers participated for Child 8 (i.e., both parents and a nanny) and only one

parent participated for child 5 (i.e., the mother). One or more caregivers in four families (n=8) attended all group sessions. Several caregivers missed at least one MTW session: one session (n=5), two sessions (n=3), three sessions (n=3), four sessions (n=2), five sessions (n=2) and eight sessions (n=1). The parents who missed five and eight sessions respectively were both fathers whose work commitments prevented their attendance. The most common reasons for parent absence were child illness and work commitments. Sixteen of the twenty-four parents/caregivers attended the three in home coaching sessions with the SLP. The remaining eight parents were unable to attend these daytime sessions due to work commitments outside the home.

#### *Parent and Child Communication Frequency*

AWC, CVC, CTC and CIC were each based on 6 to 13 hour recordings obtained using the DLP at four points in time. Due to the variability in the length of the DLP recordings, an hourly average for AW, CV, CT and CI was calculated for each recording at each time point (e.g. number of adult words/number of hours recorded) (see table 5a). No statistically significant changes in AWC, CVC, CTC or CIC were found using paired sample t-tests.

*Adult word count (AWC).* Overall, AWC appeared relatively stable from baseline to follow up with a slight increase immediately post intervention indicated by an average percentile increase 8.75 when examined in relation to normative LENA data (Gilkerson & Richards, 2008) (see table 5b). Average hour long AWCs ranged from 563.56 to 1432 words (mean=995.53) at baseline. Midway through the program, families demonstrated a slight dip in hourly adult

talk frequency ranging from 284 to 1351.55 words (mean=926.91). AWC then increased post intervention ranging from 436 to 1543 words per hour (mean=1153.25). This increase was not maintained at follow up with families ranging in talk from 263 to 1387.74 words per hour (mean=943.89). The wide range and large standard deviation for AWC indicate that two families fell below their baseline hourly talk frequency at follow up.

*Child vocalization counts (CVC).* Hourly CV frequency counts were also obtained from the DLP (see table 5a). Baseline CVs ranged from 66.24 to 277.18 (mean= 134.05). Vocalizations remained relatively stable across measures showing a slight decrease mid program (range: 36- 256.73, mean=113.95), slight increase above baseline immediately post intervention (range: 37.28 - 229.67, mean=140.19) and return to baseline levels at follow up (range: 35.3 to 311.69, mean=136.26). When compared to the normative data, two of nine children who produced vocalizations at a rate lower than the 50<sup>th</sup> percentile pre intervention surpassed the 50<sup>th</sup> percentile post intervention. On average, children showed a 9.08 percentile increase (SD=27.04) in vocalizations from baseline to post intervention (see table 5b).

*Conversational turn counts (CTC).* Hourly frequency counts of CTs between the target child and adults in his or her environment were obtained via the DLP (see table 5a). At baseline, families demonstrated 18.05 to 60.62 CTs (mean=31.48). Little change was recorded in CT frequency across time points, remaining basically stable mid intervention (range: 7.33 to 62.18, mean=30.06), post intervention (range: 9.52 to 58.83, mean=37.48) and at follow up (range: 5.76

to 80.88, mean=32.65). On average, families demonstrated a 13.33 percentile increase (SD=26.66) in CTs from baseline to post intervention, however, families were still engaging in CTs at a rate below the 50<sup>th</sup> percentile at post (see table 5b).

*Child initiation counts (CIC).* Child initiations were calculated per hour of recorded audio data. Average initiations per hour remained relatively stable across time points (baseline mean= 9.93, mid mean=7.18, post mean= 7.5, follow up 1 mean= 7.36). No significant changes in child initiations were noted through paired sample t-tests. Normative data is not available for rate of child initiations and thus, no comparison can be made.

#### *Caregiver Skill Mastery*

Caregiver skill mastery was reported through caregiver self-evaluation and clinician evaluation questionnaires. Table 6a reports mean scores for parents' self-evaluation of skills and means for clinician evaluation of skills. Table 6b describes the discrepancies that occurred between parent and clinician report. Overall, caregivers reported increases in all activity and skill categories as did the clinician. However, discrepancies occurred between parent and clinician perceptions for both individual skills and overall measures. Overall, at baseline caregivers rated themselves lower than the clinician and indicated they perceived more change post intervention than the clinician. Descriptive scores for parent self evaluation and clinician evaluation of caregiver skills are provided below.

*Caregiver skill self-evaluation.* Twenty of the twenty-four caregivers provided self-evaluations of their skills pre and post the MTW program (see table 6a). Caregivers reported their ability to accurately identify their child's stage of

communication and set appropriate communication objectives increased from an average baseline score of 2.13 to a score of 5.6 post intervention indicating that parents felt they could not perform these at baseline but could accurately set objectives approximately 50% of the time and accurately note their child's stage of communication post intervention. Caregivers also reported increases across the 15 skill items from a lack of skills at baseline (mean=2.53) to accurate implementation of the skill roughly 50% of the time after the MTW program (mean= 5.54). Across activities including people games, songs, toys and books, caregivers perceived their interactions with their children as successful less than 10% of the time before MTW (mean=2.86), while they experienced 50% success in their attempts to interact in these activities or consistent success across 4 to 5 activities after participating in MTW (mean=5.31). Caregivers considered their overall fidelity of implementation to be approximately 10% at baseline (mean score=2.37) which increased to 50% (mean score=5.06) post intervention. Similarly, they estimated that they were making use of less than 10% of the daily opportunities for communicative interaction with their children at baseline (mean score= 2.32) which increased to use of just over 50% of these opportunities post MTW (mean score= 5.5). Caregivers' gauged their ability to implement the strategies over time to be of a similar level at baseline (mean score= 2.44) but slightly higher than their ability to maximize use of communicative opportunities post intervention reporting a mean score of 6.67 indicating they believed they were over 80% likely to maintain the skills over time.

*Clinician evaluation of caregivers' skills.* The clinician provided evaluations of 16 caregivers' skills before and after the delivery of the MTW program (see table 6a). The clinician felt she was unable to rate the remaining eight caregivers as they were not present during the in home coaching sessions. The clinician reported caregivers were unable to accurately identify their child's stage of communication or set an appropriate communication objective at baseline (mean=1.39). This increased to roughly 10 to 30% accuracy (mean=3.86) post intervention. Caregivers accurately demonstrated the MTW skills about 10% of the time or in one activity pre program (mean=3.02). This increased to nearly 50% of the time or across four to five activities at post (mean=4.91). The clinician also noted that four mothers (child 2, child 3, child 6 and child 8) and one father (child 11) achieved 80% accurate implementation across skill items post intervention. Additionally, she perceived only one parent to be obtaining less than 10% accuracy across skills (child 1 mother), indicating no overall fidelity change pre to post program. Similarly, across activities the caregivers were reported to demonstrate 10 to 30% success in implementing people games, song, toys and books pre intervention (mean=3.844) while at post they demonstrated 50% success in these activities (mean=5.34). At baseline, caregivers received an average score of 2.86 for overall implementation fidelity which increased to 4.86 post intervention. The clinician also noted the caregivers increased their ability to utilize communication opportunities with their child from baseline (mean=2.5) to post intervention (mean=3.71) as well as their ability to use the skills and

strategies successfully over time from a mean score of 2.21 before intervention to a mean score of 5.0 post intervention.

### *Child Nonverbal Gestures and Language*

*MCDI gesture scores.* Children's gesture scores remained relatively unchanged across phases of intervention until follow up. Children were reported to demonstrate 9 to 36 gestures (mean= 22.33) at baseline, 5 to 40 gestures mid intervention (mean=23.45), 0 to 47 gestures post MTW (mean= 28.08) and 8 to 51 gestures at follow up (mean=27.91). Paired sample t-tests indicated significant change from baseline to follow up ( $t(10)=-2.12$ ,  $p=0.060$ ,  $d=.440$ ). When MCDI gestures were divided into early gestures (18 items) and later gestures (45 items) (Fenson et al., 2007) and examined using paired sample t-tests, no significant changes in early gestures were found. However, significant increases both post intervention ( $t(11)=-2.23$ ,  $p=0.047$ ) and at follow up ( $t(10)=-2.31$ ,  $p=0.044$ ) were found for later gestures. See table 7 for child gesture scores.

*MCDI receptive vocabulary scores.* MCDI scores were collected at four time points (see table 7). Baseline scores ranged from 0 to 208 words (mean= 98.75). Receptive vocabulary increased mid intervention (0 to 229 words, mean=107.09), post MTW (0 to 283 words, mean=130.75) and at follow up (0 to 266 words, mean=156.64). Notably, no change was reported for one child across measures (child 11). Paired sample t-tests were conducted to examine change in receptive vocabulary. Significant increases were found from baseline to post MTW ( $t(10)=-2.34$ ,  $p=0.041$ ,  $d=.389$ ) and baseline to follow up ( $t(10)=-2.75$ ,  $p=0.020$ ,  $d=.662$ ). See table 7 for child receptive vocabulary scores.

*MCDI expressive vocabulary scores.* Mean expressive vocabulary scores increased steadily across all four time points. Five children used no expressive words at baseline (child 4, 5, 7, 10, 11 and 12), with four remaining nonverbal at post and three at follow up. Total expressive vocabulary at baseline ranged from 0 to 115 words (mean=20.83). Increases were reported mid program (0 to 156 words, mean=28.27), post MTW (0 to 192 words, mean=39.75) and at follow up (0 to 244 words, mean=55.36). Four children were reported to have no expressive language post intervention (child 4, 5, 7 and 11) while two other children (child 10 and child 12) were reported to only have one expressive word at post. Paired sample t-tests indicated no significant change across measures. See table 7 for child expressive vocabulary scores.

#### *Child Engagement*

*Video engagement state change.* Paired sample t-tests were conducted in order to evaluate change in children's frequency of each of the six engagement states over the course of the MTW program. Overall, children demonstrated a statistically significant increase in the proportion of videotaped parent-child interaction intervals coded as coordinated joint attention (CJA) from baseline to both mid intervention ( $t(8)=-2.38$ ,  $p=.005$ ,  $d=1.203$ ) and post intervention ( $t(8)=-2.67$ ,  $p=0.028$ ,  $d=.957$ ). Further, a statistically significant decrease in object focused intervals from baseline to mid intervention ( $t(9)=2.40$ ,  $p=0.040$ ,  $d=1.255$ ) and baseline to post intervention ( $t(9)=3.12$ ,  $p=0.012$ ,  $d=1.348$ ). See table 8 for mean percentages for each of the six engagement states across time points. Group

mean change between time points for each of the engagement states are discussed below.

On average, a slight overall increase in intervals coded as unengaged was found mid intervention (mean=2.93%) and post intervention (mean=2.71%) with children spending an average of 22.29% of intervals unengaged after intervention. However, midway through intervention three children showed a decrease in the percentage of intervals where he or she was unengaged (-2.6% to -19.03%) while two children showed further decrease from baseline at post (-8.16 to -42.11%). Overall, children spent an average of approximately 15% of their intervals onlooking or passively observing the person or objects without participating. Mid intervention, six children showed a decrease (mean= -8.95%) in the onlooking frequency while post intervention, onlooking frequency decreased in seven children (mean=-13.68%) from baseline with children spending just over 7% of their time in the onlooking state at post. On average, the frequency of person focused intervals increased both mid (mean= 6.42%) and post (mean= 5.06%) program from a baseline average of 8%, while object focused intervals decreased mid (mean= -16.93%) and post (mean= -18.28%) program from a baseline average of 29.96%. Children demonstrated a range in frequency of passive joint attention (PJA) intervals pre intervention from 0 to 23.68%. Change in PJA frequency was also variable both mid intervention (-24.17% to 36.86%, mean= 1.21%) and post intervention (-24% to 36.86%, mean= -4.57%). Overall, a positive average change was noted in coordinated joint attention (CJA) frequency both mid intervention (mean=10.79%) where six of nine children showed

increased CJA and post intervention (mean=16.06%) where seven children demonstrated increases. Three children showed no positive change. Children who showed increases in CJA (n=7) were coded as engaging in CJA up to 71.43% (mean= 34.2%) of intervals coded CJA post intervention compared to 15.79% (mean=10.00%) before MTW was introduced.

### *Relationships Among Dyadic Engagement, Child Language and Parent Skill Mastery*

The goal of the MTW program is to provide parents with the knowledge and skills to successfully engage their child in language learning opportunities. Therefore, an increase in the frequency of families' interactions and increases in child outcomes in the language and communication domain were anticipated. Bivariate correlations indicated that change in coordinated joint attention (CJA) from pre to post MTW was significantly correlated with change in children's prelinguistic gestures ( $r(11) = .634, p < .05$ ). A significant negative correlation was found between change in CJA and the language spoken in the family's home ( $r(11) = -.776, p < .05$ ) where speaking a language other than English in the home was related to lower percentages of CJA intervals. No other parent demographic characteristics (e.g. parental education and parent chronological age) were significantly related to child or parent outcomes.

Attendance was examined for mothers and fathers (including other primary caregivers) separately. A significant negative correlation emerged between father's attendance of the in home sessions and mothers' post intervention fidelity ( $r(7) = -.83, p < .01$ ). Mothers' total attendance (or dosage-

combined in home and group sessions) was significantly related to children's decreased frequency of being unengaged post intervention ( $r(9)=-.75, p<.05$ ) and decreased object focused engagement post intervention ( $r(9)=-.71, p<.05$ ). Two unanticipated negative correlations were found between mothers' overall skill mastery and two child talk outcomes that did not show significant change between baseline and post intervention measures (expressive language post intervention ( $r(8)=-.64, p<.05$ ), frequency of initiations post intervention ( $r(8)=-.77, p<.01$ )). However, the clinician's rating of mothers' fidelity was not related to either variable. Clinician ratings of mothers' fidelity were lower than the mothers' self-evaluation of their skills, indicating that mothers' may perceive themselves as more competent and accurate in their implementation than they are when directly observed. Mothers' overestimation of their skills may have led to these unanticipated correlations.

Several child language and talk variables post intervention were significantly related and related with the child's developmental age (MCDI receptive language scores ( $r(11)=.32, p<.01$ ), MCDI expressive language scores ( $r(11)=.85, p<.01$ ), MCDI early gesture scores ( $r(11)=.59, p<.05$ ), child vocalizations ( $r(11)=.66, p<.05$ ) and child initiations ( $r(11)=.72, p<.01$ )). Significant positive correlations were found between child developmental age and change score for expressive language ( $r(11)=.658, p<.05$ ) and child initiations ( $r(11)=.79, p<.01$ ) at all time points. These relationships indicate that toddlers who entered the MTW program with greater language skills and had progressed

further developmentally, exited the MTW program with greater gains in coordinated engagement and communication than their program peers.

### Discussion

The purpose of this study was, first, to examine the base frequency of communicative interaction between toddlers with ASD and their parents and other primary caregivers. Second, to explore the degree to which parents master skills presented in the MTW program and finally, to determine if participation in this program is associated with the nature and frequency of dyadic interaction between parent and child. Overall, the twelve families of toddlers with ASD spoke at rates lower than average demonstrated by families of typically developing toddlers (Gilkerson & Richards, 2008). Caregivers increased their talk immediately after participation in the MTW program, however, these increases were not sustained over time. Bidirectional relationships between child language outcomes and parent talk outcomes were seen with 75% of the families. On average, parents perceived themselves as having very few basic interaction skills prior to participating in MTW. However, both the parents and the clinician reported an average increase to 50% implementation fidelity post intervention. Children demonstrated significant increase in coordinated joint attention and receptive language after the MTW program. Post intervention increased frequency of coordinated engagement and decreased frequency of object engagement were significantly related to increased child receptive language.

### *Base Communicative Frequency and the Influence of MTW*

Overall, when compared to families of typically developing toddlers in the LENA normative language study, the families of toddlers with ASD included in this study spoke at a rate below the normative 50<sup>th</sup> percentile (1025.75 AW/hour) producing 995.89 (range: 563.56 to 1435.02) adult words per hour before intervention. On average, families were also speaking less than working class families (1250 words/hr) and at a rate of less than half that of the professional families (2150 words/hr) as reported by Hart and Risley (1995). A great deal of variability was observed across the 12 families and of concern were two families who were speaking at rates under the normative 20<sup>th</sup> percentile, close to those of Hart and Risley's lowest talking group, families on welfare, producing roughly 620 words per hour. As noted by Hart and Risley (1995), the net impact of this impoverished language environment is daunting when the relationship of adult talk to child vocabulary growth, vocabulary use and school performance in later years is considered. For children with ASD who are already at substantial risk for ongoing challenges and delays in communication and language, the clinical implications for child development must be considered. The goal of the MTW program is to help parents develop a basic set of skills designed to increase their ability to successfully engage their child who has ASD in communicative interactions. Accordingly, an increase in frequency and duration of communication was anticipated after families' participation in this program. Although the increase in adult talk frequency immediately after intervention was not statistically significant, several families demonstrated increases in hourly talk

frequency that were consistent with an average percentile change of 8.75 (SD= 22.88) when examined in comparison to the LENA normative data. No family demonstrated adult talk frequencies at or above the 80<sup>th</sup> percentile pre intervention, however post intervention, three families surpassed the normative 80<sup>th</sup> percentile (families 1, 3 and 6). Further, at baseline, seven families fell below the 50<sup>th</sup> percentile in talk frequency (families 2, 4, 5, 7, 9, 10 and 12). At post, four families met or surpassed this benchmark. These positive changes in adult talk indicate that included families who were speaking at frequencies considered low or at risk (Gilkerson & Richards, 2008; Hart & Risley, 1995) were making important strides toward levels of talk frequency associated with greater child language outcomes (Hart & Risley, 1995). However, when adult talk frequency was examined two months beyond the intervention, increases noted immediately post program were not sustained in full, with the majority of families returning to talk levels close to that of baseline. The increase in talk frequency experienced immediately post program indicates that this form of intervention can support parents in enriching the child's language environment by altering their amount of talk at home. However, the decline in adult talk frequency at the follow up measure may indicate a need for additional supports and services in order to assist families in maintaining and further increasing their child directed communications once they have exited the MTW program.

#### *Caregiver Mastery of MTW Skills and Strategies*

Although caregivers' skill mastery scores were not obtained through direct observation, parents' perception of their skills and confirmed by the Hanen Centre

trained clinician provide a unique window into the relative accuracy of skill mastery. Overall, there was fair agreement between the caregivers' self-evaluation and the clinician's perception of their skill mastery (see table 6b). Caregivers perceived their skills as slightly lower than the clinician pre program, and perceived a greater increase in their skills post program than the clinician. Generally, caregivers entered the MTW program with knowledge of very few of the interaction skills presented in the MTW program. For some skills, especially those introduced at the beginning of the program, the clinician reported that parents demonstrated accurate use at baseline. For example, the clinician reported that at the start of the program parents could implement the following skills in 2 to 3 activities (score of 4.0 or higher): being face to face, joining in the child's play, having fun and engaging the child in an activity. However, the caregivers did not view themselves as competent with any of the skill items at baseline, with no item receiving a score of 4.0 or higher before participation in MTW. Further, parents reported that they felt particularly uncomfortable (mean score less than 2.0) with the items "observe, wait and listen" (OWL) and "give a reason to communicate and wait". This discrepancy indicates that although parents and other caregivers may have emerging abilities with basic strategies to engage their children, they do not view themselves as competent or skilled. In particular, they do not view themselves as capable of creating successful opportunities for language via the use of wait time or observation of the child's interests and activities that are key early concepts in the MTW program. Further, discrepancies occurred between parent and clinician report around success across activities (people games, songs,

toys and books) before intervention, where parents and other caregivers felt they were experiencing less than 10% success whereas the clinician reported 20% greater success in people games and 10 to 20% greater success across the other three activities.

Overall, parents and other caregivers felt slightly more confident in their overall implementation fidelity than the clinician post intervention but on average, neither felt the parents obtained the ability to accurately implement more than 50% of the skills and strategies presented in the MTW program. However, the clinician gave 5 of 24 caregivers (all primary at home parent including one father and four mothers) scores of at least 6.0, indicating that these caregivers achieved at least 80% implementation fidelity. Item scores indicate that parents felt they achieved roughly the same level of success with each item presented in the program with about 10% variation. Average achievement of 50% implementation fidelity over an eight week program consisting of 24.5 hours of combined group and individual training with a skilled clinician is significantly less than published fidelity data (i.e. parents obtaining fidelity scores at or above 80% on average) observed with caregivers of toddlers with ASD who are participating in other parent-mediated intervention programming delivered via group instruction (e.g. 15 hour group delivery of Pivotal Response Treatment (Minjarez, Williams, Mercier & Hardan, 2010) or individual instruction (e.g. Early Start Denver Model (Vismara et al., 2009); joint attention intervention, (Kasari, Gulsrud, Wong, Kwon & Locke, 2010)). However, when considering overall parent implementation fidelity amongst these 12 families, it is notable that the clinician provided skill

evaluations for only 16 of the 24 parents and other caregivers who were included in this study. The clinician felt she was unable to accurately assess the skills of the other eight parents because they were not present at the in home coaching sessions due to work commitments outside of the home. This focus on the home caregiver at the expense of the parent working outside the home is a significant limitation of the community delivery of the MTW program and an important consideration for clinicians and service providers delivering this program in real world settings. The lack of individualization and nonspecific delivery of the MTW program is not consistent with the recommendations of the National Research Council (2001) which consider the individualization of intervention to the needs of the child and family a key factor to evidence based practice.

In terms of the caregivers' ability to utilize communication and interaction opportunities throughout the day and over time, the clinician reported low scores indicating parents were making use of roughly 20% of their daily opportunities to interact with their child and that parents would maintain correct use of the skills in roughly half of these opportunities. However, the five parents perceived by the clinician as achieving over 80% implementation fidelity were also rated as better able to maintain accurate use of the skills (mean=5.8) and to identify opportunities for interaction (mean=6.2). Yet, this overall low estimation of parents' ability to identify and correctly implement communication strategies over time may call into question the intensity and density of the MTW intervention that parents are able to deliver without further supports, the limitations of which can diminish the positive effects of intervention (Kasari et al., 2010). As such, these factors should

be considered by clinicians when levels of parent mediated and clinician mediated intervention services are weighted.

### *Bidirectional Parent-Child Talk and Language Changes*

Although changes in child CVs, CTs and initiations were not significant, these changes were significantly correlated with increases in the children's MCDI expressive language scores. This correlation speaks to the validity of the DLP as a tool for sampling child language in uncontrolled environments. Interesting patterns were observed between the DLP measure of adult talk frequency and child language. Generally, as adult talk frequency increased across the MTW program, child expressive and receptive language (MCDI) increased as well. Further, the timing and slope of these increases in both parent and child talk occurred at similar points in time for 3 families (see figure 2). Additionally, in families where little to no increase in adult talk frequency occurred, little to no child language change was also noted (n=5). This sense of interrelated parent and child change is consistent with the notion of bidirectional change noted in transactional theory (Sameroff & Chandler, 2003). Based on these changes, four parent-child talk profiles were developed (see figure 3). These four profiles include: 1) increases in child MCDI language scores and increase in adult talk frequency (n=3); 2) increases in child MCDI language scores and little to no increase in adult talk frequency (n=1); 3) little to no increase in child MCDI language scores and increases in adult talk frequency (n=2) and 4) no increase in child MCDI or adult talk frequency (n=6). Only three families demonstrated talk consistent with the desirable profile of increasing parent talk frequency and child

language patterns. This pattern between mother's overall MTW skill fidelity and child language increase is evident within the parent-child talk profiles. On average, mothers of families in profile 1 (child and parent increase profile) were perceived by the clinician to be implementing the strategies with 80% fidelity on average (mean score=6.0) whereas mothers of children in the fourth profile (little to no parent or child change), were reported by the clinician to be demonstrating roughly 30% fidelity (mean score=4.0). As such, it appears that children talk more with parents who are more successful at creating language learning opportunities for their children. There are several speculative factors that could have contributed to the second and third parent-child talk profiles. The increase in child language but lack of change in parent talk present in profile 2 (child 1) may be explained by the presence of a second primary caregiver (grandparent) whose MTW skill fidelity was much greater (clinician fidelity score of 6) than the parent (clinician fidelity score of 2) post intervention. Further, the lack of child language change despite parent talk increase in profile 3 (family 2) may be explained by the child's change in diagnosis to Rett's Syndrome. This profile for the second family (child 11) may be explained by the child's biomedical complications (gastrointestinal issues) during the program.

The increases in children's CJA noted in this sample also concur with the four parent-child talk profiles. Children in the first profile (parent and child increases) demonstrated some of the greatest increases in CJA spending a mean of 38.35% of the interaction coordinated with the caregiver and the activity or object. Although post intervention video data was not available for the third child

included in this profile (child 9), mid intervention, the child engaged in CJA during 53.97% of his video taped interactions. This is in contrast to children in the fourth profile (little to no child or adult change), who on average engaged in CJA during 19% of the interaction with three children never demonstrating CJA at post, as well as families the third profile (22.85%). The family in the second profile was not filmed immediately post intervention but demonstrated 8.33% CJA when filmed approximately two months after intervention.

### *Influence of Demographic Factors*

The child characteristic primarily related to outcomes variables was developmental age (DA). DA was significantly correlated with multiple language variables post intervention including early gestures, receptive language, expressive language, CTCs and CVs. These relationships indicate that children who entered the MTW program with higher DA, exited the program with greater communication and language skills.

Significant negative correlations were also noted between the language spoken in home (English vs. languages other than English) and several child outcome variables post intervention including MCDI early gestures, MCDI gestures and MCDI receptive language. These results indicate that in this sample, the toddlers of caregivers who were speaking languages other than English in the home were obtaining lower language and gesture scores after intervention than toddlers of caregivers who were speaking English as their primary language. This draws attention to considerations regarding the appropriateness of the MTW program as a parent education program for families who are English language

learners. The delivery and or content of the program may need to be altered to better suit the needs of these families.

### *Influence of MTW on Child Engagement and Child Language*

This study contributes an examination of engagement state change and CJA to the literature which has not previously been explored in published MTW studies (Girolametto et al., 2007; McConachie et al., 2005). Significant increases in children's coordinated joint attention (CJA) as well as significant decreases in object focused engagement were found post participation in MTW. Effect size calculations indicate the increase in CJA and decrease in object engagement were large (Cohen, 1988) both mid and post intervention. Significant increases in children's receptive language and gestures using the MCDI were also found. Effect size calculations indicated the increase in receptive language at post and gestures at follow up were small (Cohen, 1988) but the increase in receptive language at follow up was representative of a medium effect (Cohen, 1988). These patterns of improvement in CJA post MTW were similar to findings from other parent-mediated interventions. For example, the pattern of child engagement change in coordinated and object engagement during dyadic interaction is similar to that of another developmental parent-mediated interventions with a sample of toddlers of comparable age (Kasari et al., 2010). However, while children in the current study achieved slightly lower post intervention levels of CJA (i.e., mean=24 (23.9) percent CJA intervals) than that of the sample examined by Kasari et al (2010) (i.e., mean=42.85 (19.96) percentage CJA intervals post intervention) the average magnitude of change from pre to post was comparable.

Higher CJA scores at post test were significantly correlated with children's higher prelinguistic gesture scores. This relationship may predict a favorable prognosis for these children based on results from Siller and Sigman (2008) who found that increased child responsiveness to parental bids for joint attention predicted favorable language development at age nine.

### *Strengths and Limitations*

Community based research offers both strengths and limitations for researchers. Data collection in the child's natural language learning environment via the DLP allows researchers to access aspects of the child's natural language environment that may otherwise go unknown due to the intensity and intrusive nature of data collection procedures such as direct observation or video footage. However, examining the child in his or her natural environment increases the variability and number of external factors that enter the data (e.g. parent/child characteristics including ethnicity, language at home, child's developmental level). This variability can provide unique insights into the individual experience of families and the challenges that community clinicians may encounter when delivering such programming in real world settings. Yet, this variability also clouds the researchers' ability to generalize findings beyond the sample and decreases statistical power.

The delivery of the intervention by community clinicians also served to provide both strengths and limitations. This method of delivery allowed the researchers' access to a very specific population as well as access to two Hanen trained clinicians implementing the program in a community setting. However,

the study was also limited by the schedule and recruitment of community children to the service provider's program for infants and toddlers diagnosed with ASD leading to a relatively small sample of 12. Although caregivers in this study achieved lower levels of implementation fidelity, the community based delivery of the intervention in comparison to a controlled research or laboratory setting must be considered. It is questionable whether or not we can expect the same levels of parent skill mastery in a community delivery program due to the increased flexibility and adjustments in implementation (i.e. scheduling of in home visits) required to deliver real world community based intervention.

#### *Future Directions*

This study is currently being extended to include a qualitative study examining parents' experience in the MTW program. This examination will provide insight into parents' learning process as they progress through the MTW program in order to further explore implementation fidelity and intervention density. Further, the community service provider plans to continue to provide the MTW program and as such, the opportunity exists to continue to increase the number of families included in the current database.

The 12 included families are currently being assessed through a second follow up measure to take place nine months post intervention where parents have received no further parent training supports. Second follow up data has been collected for six families which indicates a drastic increase in MCDI scores and AWC (above the 98<sup>th</sup> percentile) in one family. This late blooming of child

language and adult talk in this family may indicate a possible sleeper effect of the MTW program that warrants further exploration.

Future research could also examine the impact of the individual coaching sessions and possible discrepancies in parent learning for those caregivers who are not present for the individual coaching sessions due to work commitments outside of the home in comparison to parents who do receive this coaching. Further, an examination of potential dosage effects related to individual coaching on child language outcomes may provide interesting insights.

Although the current study provides information regarding parents' skill mastery, evidence regarding how this learning translates into intervention quantity or density across the child's day had yet to be established. The NRC recommends 25 hours a week of intensive intervention while early Lovaas studies recommend up to 40 hours a week of intervention. It is still relatively unknown whether or not when placed in the hands of the parents, if children will receive comparable quality of intervention and increased quantity at the range recommended in the extant literature. Examination of intervention density could be a future application of the DLP to provide information around this topic.

### Conclusion

Overall parents demonstrated increases in talk frequency and increases in skill mastery immediately post participation in the MTW program. However, on average both parent and clinician report indicated that parents and other caregivers learned to accurately and successfully implement roughly 50% of the MTW skills and strategies. The clinician also reported little confidence that

caregivers would continue to provide accurate and intense use of teachable language and communication moments over time. Post intervention, children demonstrated significant increases in receptive and expressive vocabulary as well as increases in CJA and decreased focus on object alone during dyadic interactions. Further, the increase in children's CJA was found to be significantly related to increased child prelinguistic gesture MCDI scores. These findings support the contention that the MTW program may provide parents and other caregivers with a set of basic skills that support their ability to create opportunities for shared engagement and language learning with their toddlers.

Table 1: Participant Characteristics

<b>Child</b>	<b>C. A.</b>	<b>D.A.</b>	<b>Gender</b>	<b>Ethnicity</b>	<b>BL MCDI Receptive/ Expressive</b>	<b>Language in Home</b>	<b>Parent Education</b>
<b><i>Cohort 1</i></b>							
Child 1	37	22	M	Caucasian	192/115	English	HS (m)
Child 2	33	8	F	Caucasian	208/20	English	UD (m & f)
Child 3	31	12	M	Caucasian	193/2	English	DC (m & f)
Child 4	31	3	M	Caucasian	49/0	English	Some HS (m & f)
Child 5	39	6	M	Caucasian	39/0	English	DC (m & f)
Child 6	37	6	F	Asian	61/22	Urdu/ English	Master's Degree (m & d)
Child 7	29	4	M	Asian	31/0	Tagalog/ English	DC (m & f)
<b><i>Cohort 2</i></b>							
Child 8	35	11	F	Caucasian	112/34	English	Doctoral (m)/ DC (d)
Child 9	34	16	M	African Canadian	100/57	English	UD (m)/ DC (d)
Child 10	31	12	M	Asian	161/0	English	Some college (m)/ HS(f)
Child 11	28	2	F	African Canadian	0/0	Amharic/ English	UD (m)/ HS (f)
Child 12	31	6	M	Caucasian	39/0	English/ French (d)	UD (m)/ DC (f)

C.A.= Chronological Age in months; D.A.= Developmental Age in months; MCDI Receptive/Expressive= MacArthur Communicative Development Inventory receptive and expressive scores at baseline; parent education (m)= mother's education level; parent education (f)= father's education level; HS= high school; diploma/certificate= DC; Undergraduate degree= UD

Table 2: Hanen MTW Group Session Content

<b>Session Number</b>	<b>Description of Content</b>
1: Get to Know more About your Child's Communication	<ul style="list-style-type: none"> <li>•Stages of communication, figuring out how your child learns (own agenda, requestor, early communicator, partner stages).</li> <li>•Basics of communication and why we communicate.</li> <li>•Understand child's sensory preferences/issues</li> <li>•<b>Strategy:</b> <i>Give a reason to communicate and wait.</i></li> </ul>
2: Follow your Child's Lead	<ul style="list-style-type: none"> <li>•Review highlights of family videos, showing families giving their child a reason to communicate and wait</li> <li>•<b>Strategy:</b> <i>OWL- Observe, Wait, Listen</i></li> <li>•<b>Strategy:</b> <i>Four I's- Include child's interests, Interpret, Imitate, Intrude</i></li> </ul>
3: ROCK in People games and Songs	<ul style="list-style-type: none"> <li>•Using OWL and the Four I's in people games and music</li> <li>•Create a song for a tough routine</li> <li>•<b>Strategy:</b> <i>Introduction to ROCK- Repeat, Objective (Set a Goal), Cue (prompting), Keep it fun</i></li> </ul>
4: ROCK in your Routines	<ul style="list-style-type: none"> <li>•Umbrella of communication- different types of communication</li> <li>•Using ROCK strategy in your routines</li> <li>•Information on cues- least to most prompting, different kinds of prompts</li> <li>•Types of questions- how to use different types of questions to create language learning opportunities</li> <li>•<b>Strategy:</b> <i>Introduction to Four S's- Say less, stress, go slow, show</i></li> </ul>
5: Use Visual Helpers	<ul style="list-style-type: none"> <li>•Using visuals in your routines</li> <li>•Visuals created by clinic staff and sent home with families</li> </ul>
6: Bring on the Books	<ul style="list-style-type: none"> <li>•Using MTW strategies with books</li> <li>•Understanding how to utilize books with children at each stage of communication</li> <li>•How to read with a child at each stage of communication</li> <li>•Families make a book for their child</li> </ul>
7: Take Out the Toys	<ul style="list-style-type: none"> <li>•How to use toys at different stages of play to elicit language</li> <li>•Joint attention (reference parent and toy)</li> </ul>
8: Let's Make Friends	<ul style="list-style-type: none"> <li>•Stages of peer play</li> <li>•Strategies for making friends</li> <li>•Review and social gathering</li> </ul>

Table 3. Criteria for Clinician Evaluation of Parent Learning

	Low (1, 2)	Mid (3, 4, 5)	High (6, 7)
Stage of Communication and Objective Setting	<p>(1) Parent never accurately notices child's stage and never sets appropriate objectives</p> <p>(2) Parent may have accurately guessed the child's stage or set an appropriate goal but true comprehension was not evident</p>	<p>(3) Parent is beginning to notice child's stage and set appropriate goals effectively 10% of the time or with one activity or routine</p> <p>(4) Parent is beginning to notice child's stage and sets appropriate goals effectively 30% of the time or with three activities or routines</p> <p>(5) Parent is beginning to notice the child's stage and sets appropriate goals effectively 50% of the time or with half of the routines or activities.</p>	<p>(6) Parent identifies the child's stage and goals 80%</p> <p>(7) Parent identifies the child's stage and goals 100% of the time</p>
Skills	<p>(1) Parent never demonstrates the skill</p> <p>(2) Parent has demonstrated this skill on one occasion</p>	<p>(3) Parent has demonstrated skill 10% of the time or consistently within one activity or routine</p> <p>(4) Parent has demonstrated skill 30% of the time or consistently within two-three activities or routines</p> <p>(5) Parent has demonstrated skill 50% of the time or consistently within four-five activities or routines</p>	<p>(6) Parent demonstrates skill 80% of the time in all routines or activities attempted</p> <p>(7) Parent demonstrates skill 100% of the time in all routines or activities attempted</p>
Activities	<p>(1) Parents attempts to initiate an activity are ineffective</p> <p>(2) Parent inconsistently attempts to</p>	<p>(3) 10% of parent attempts to initiate an activity are successful or consistently successful with 1 activity</p> <p>(4) 30% of parent attempts to initiate an activity are successful or consistently successful with 3 activities</p>	<p>(6) 80% of parent attempts to initiate are successful</p> <p>(7) 100% of parent attempts to initiate are successful</p>

	initiate an activity but are mostly unsuccessful	(5) 50% of parent attempts to initiate an activity are successful or consistently successful with 4-5 activities	
Generalization Estimation	(1) MTW strategies are never accurately implemented  (2) Parent attempts MTW strategies but are poorly implemented	(3) 10% of MTW strategy attempts are accurately implemented across routines and opportunities  (4) 30% of MTW strategy attempts are accurately implemented across routines and opportunities  (5) 50% of MTW strategy attempts are accurately implemented across routines and opportunities	(6) 80% of MTW strategy attempts are accurately implemented across routines and opportunities  (7) 100% of MTW strategy attempts are accurately implemented across routines and opportunities
Maintenance Estimation	(1) I have no confidence the parent will maintain these skills  (2) I have limited confidence that the parent will maintain these skills	(3) The parent may be able to maintain these skills in at least 1 situation  (4) The parent may be able to maintain these skills in a couple of situations  (5) The parent may be able to maintain these skills about half of the time	(6) The parent may be able to maintain these skills most of the time  (7) This parent could act as a parent mentor for parents entering the MTW program

Table 4: Parent and Other Caregiver Percentage Session Attendance- Group and In Home

<b>Child</b>	<b>Mother: Group Attendance</b>	<b>Father/Other Caregiver: Group Attendance</b>	<b>Mother: In Home Attendance</b>	<b>Father/Other Caregiver: In Home Attendance</b>
<b>1</b>	62.5%	62.5%	100%	100%
<b>2</b>	100%	37.5%	100%	0%
<b>3</b>	100%	100%	100%	0%
<b>4</b>	87.5%	75%	100%	0%
<b>5</b>	37.5%	0%	100%	0%
<b>6</b>	100%	100%	100%	0%
<b>7</b>	50%	50%	100%	0%
<b>8**</b>	100%	100%	33.33%	100%
<b>9</b>	62.5%	75%	100%	100%
<b>10</b>	87.5%	0%	100%	100%
<b>11</b>	87.5%	75%	0%	100%
<b>12</b>	87.5%	87.5%	100%	100%

\*Percentage of a total of 8 group sessions and 3 in home coaching sessions

\*\*A third caregiver participated in MTW (nanny). This caregiver attended 100% of the group and in home sessions

Table 5a: Range, Mean Hourly Frequency and Standard Deviation Per Time Point

<b>Phase</b>		<b>AWC</b>	<b>CVC</b>	<b>CTC</b>
<b>Baseline</b>	Range	563.56-1435.02	66.25-277.18	18.05-60.62
	Mean	995.89	134.05	31.48
	Stan. Dev	299.13	66.46	13.20
<b>Mid MTW</b>	Range	283.1-1510.51	36-256.73	8.1-62.18
	Mean	927.7	113.95	30.06
	Stan. Dev	405.82	67.99	17.78
<b>Post</b>	Range	441.39-2123.52	37.28-278.4	9.52-58.83
	Mean	1153.84	140.19	37.48
	Stan. Dev	523.33	81.26	22.06
<b>Follow Up 1</b>	Range	263.11-1387.74	35.3-402.41	5.76-75.18
	Mean	1060.25	136.26	32.65
	Stan. Dev	326.92	121.65	24.75

Table 5b. Normative Percentile of AWC, CVC and CTC per Time Point

Child	Baseline	Mid MTW	Post MTW	Follow Up
Child 1				
AWC	75	15	80	65
CVC	85	75	90	90
CTC	80	70	90	90
Child 2				
AWC	25	50	50	65
CVC	<10	<10	<10	<10
CTC	<10	<10	10	10
Child 3				
AWC	65	65	90	65
CVC	10	50	<10	10
CTC	30	70	45	40
Child 4				
AWC	20	10	25	25
CVC	55	<10	<10	<10
CTC	30	<10	<10	<10
Child 5				
AWC	35	10	10	40
CVC	15	<10	<10	10
CTC	20	<10	<10	10
Child 6				
AWC	70	80	95	70
CVC	25	15	40	40
CTC	40	35	50	45
Child 7				
AWC	20	50	65	10
CVC	10	10	70	<10
CTC	<10	20	80	<10
Child 8				
AWC	65	70	70	70
CVC	90	85	75	99
CTC	75	80	75	90
Child 9				
AWC	10	10	35	35
CVC	30	25	80	<10
CTC	20	15	80	<10
Child 10				
AWC	40	70	40	ND
CVC	<10	10	25	ND
CTC	20	30	30	ND
Child 11				
AWC	65	45	50	70
CVC	20	20	45	35
CTC	20	20	40	40

Child 12				
AWC	35	25	10	65
CVC	20	<10	<10	10
CTC	15	<10	<10	15

\*Normative scores are published in Gilkerson & Richards, 2008

ND= No Data

Table 6a: Parents and Other Caregivers' Self-Evaluation of Skills and Clinician Evaluation of Caregiver Skills

<b>Skill/Activity</b>	<b>Average (Range) Parent Pre Intervention Rating</b>	<b>Average (Range) Parent Post Intervention Rating</b>	<b>Average (Range) Clinician Pre Intervention Rating</b>	<b>Average (Range) Clinician Post Intervention Rating</b>
<b>Stage of Communication/ Setting Objectives</b>	<b>2.13 (1-3)</b>	<b>5.60 (4-7)</b>	<b>1.39 (1-2)</b>	<b>3.86 (2-7)</b>
<b>Skill (mean)</b>	<b>2.53</b>	<b>5.54</b>	<b>3.02</b>	<b>4.91</b>
Reason and Wait	1.84	5.50	1.93	5.14
Face to Face	2.47	5.65	4.23	5.62
Join in	2.37	5.35	4.14	5.36
OWL	1.79	5.45	3.64	5.36
Imitate	3.05	6.65	2.43	3.64
Interpret	2.90	5.65	2.64	3.86
Intrude	2.85	5.45	3.00	5.07
Repeats	2.58	5.37	2.86	5.36
Explicit Cues	2.80	5.75	2.57	5.00
Natural Cues	2.25	5.20	2.29	4.36
Keep it Fun	3.70	5.90	5.00	5.57
Engagement	2.32	5.20	4.43	5.29
Four S's	2.30	5.45	3.21	5.00
Labels	2.21	5.28	2.86	4.57
Expand	2.58	5.31	2.77	4.39
<b>Activities (mean)</b>	<b>2.86</b>	<b>5.31</b>	<b>3.84</b>	<b>5.34</b>
People Games	3.15 (1-6)	5.60 (3-7)	4.17 (2-6)	5.42 (2-7)
Songs	3.0 (1-6)	5.35 (2-7)	3.91 (2-7)	5.46 (4-7)
Toys	2.90 (1-6)	5.25 (3-7)	3.57 (2-6)	5.29 (3-7)
Books	2.37 (1-7)	5.05 (2-7)	3.73 (1-7)	5.34 (3-7)
<b>Overall Implementation Fidelity</b>	<b>2.37 (1-6)</b>	<b>5.06 (3-7)</b>	<b>2.86 (1-6)</b>	<b>4.86 (2-7)</b>
<b>Utilizes Communication Opportunities</b>	<b>2.32 (1-6)</b>	<b>5.50 (3-7)</b>	<b>2.50 (1-5)</b>	<b>3.71 (3-6)</b>
<b>Maintenance</b>	<b>2.44 (1-7)</b>	<b>6.67 (3-7)</b>	<b>2.21 (1-5)</b>	<b>5.0 (2-7)</b>

\*Where a score of 1-2=no success in the activity/unable to implement the skill accurately; 3= correct use 10% of the time or within one activity; 4= correct use 30% of the time or within 2-3 activities; 5= correct use 50% of the time or within 4-5 activities; 6= correct use across 80% of all attempts; 7=100% success across all attempts and activities

Table 6b. Discrepancies Between Parent Self Evaluations and Clinician Evaluation of Parent Skill Mastery

<b>Skill/Activity</b>	<b>Discrepancy Between Average Pre Scores (Parent-Clinician)</b>	<b>Discrepancy Between Average Post Scores (Parent-Clinician)</b>
<b>Stage of Communication/ Setting Objectives</b>	<b>0.74</b>	<b>1.74</b>
<b>Skill and Strategies (mean)</b>	<b>-0.49</b>	<b>0.63</b>
Reason and Wait	-0.09	0.36
Face to Face	-1.73	0.03
Join in	-1.77	-0.01
OWL	-1.85	0.09
Imitate	0.62	3.01
Interpret	0.26	1.79
Intrude	-0.15	0.38
Repeats	-0.28	0.01
Explicit Cues	0.23	0.75
Natural Cues	-0.04	0.84
Keep it Fun	-1.30	0.33
Engagement	-2.11	-0.09
Four S's	-0.91	0.45
Labels	-0.65	0.71
Expand	-0.19	0.92
<b>Activities (mean)</b>	<b>-0.98</b>	<b>-0.03</b>
People Games	-1.02	0.18
Songs	-0.91	-0.11
Toys	-0.67	-0.04
Books	-1.36	-0.29
<b>Overall Implementation Fidelity</b>	<b>-0.49</b>	<b>0.2</b>
<b>Utilizes Communication Opportunities</b>	<b>-0.18</b>	<b>1.79</b>
<b>Maintenance</b>	<b>0.23</b>	<b>1.67</b>

Table 7: MCDI Words and Gesture: Receptive and Expressive Vocabulary and Gestures

Child	Baseline			Mid MTW			Post MTW			Follow Up		
	Rec	Exp	Gest	Rec	Exp	Gest	Rec	Exp	Gest	Rec	Exp	Gest
1	192	115	29	229	156	37	283	185	32	260	242	38
2	193	2	20	196	4	25	247	4	28	252	28	30
3	208	20	16	175	8	15	184	6	13	194	1	8
4	49	0	24	30	0	27	130	0	35	253	0	37
5	39	0	33	47	0	36	83	0	47	168	3	51
6	61	22	22	87	35	25	101	49	30	83	45	34
7	31	0	9	44	0	5	57	0	11	65	2	17
8	112	34	29	ND	ND	ND	96	39	42	138	44	15
9	100	57	36	149	105	40	211	192	47	266	244	50
10	161	0	29	154	2	23	170	1	25	ND	ND	ND
11	0	0	9	0	0	9	0	0	7	0	0	11
12	39	0	12	67	1	16	7	1	0	22	0	16

\*Rec= Receptive vocabulary; Exp= Expressive vocabulary; Gest= Gestures;  
 ND=No Data

Table 8: Mean Percentage of Child Engagement State Intervals

Engagement State	Baseline	Mid MTW	Post MTW
Unengaged	18.99%	22.51%	22.29%
Onlooking	15.30%	12.61%	7.29%
Person	8.00%	14.21%	14.60%
Object	29.96%	15.50%	13.00%
Passive Joint Attention	10.37%	12.00%	5.80%
Coordinated Joint Attention	7.32%	19.00%	24.00%

Figure 1: Mean Hourly adult word count (AWC) Per Time Point

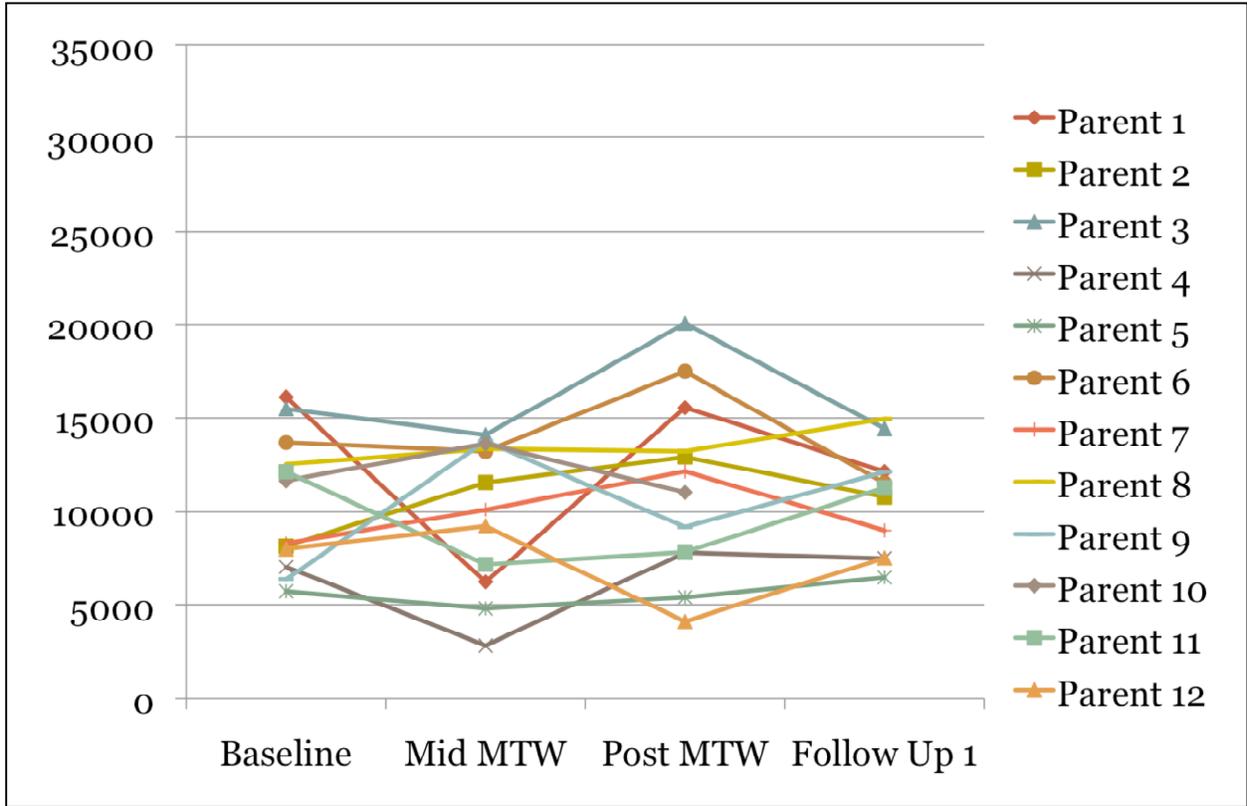


Figure 2. Example of a Profile 1 Family- Bidirectional Parent-Child Talk and Language Change

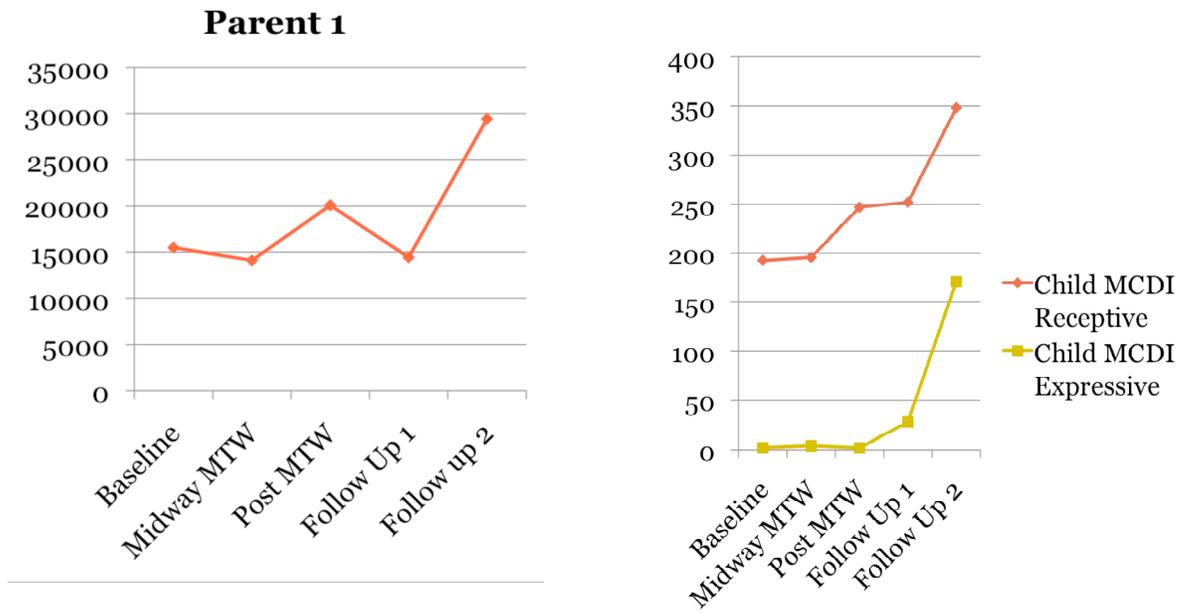
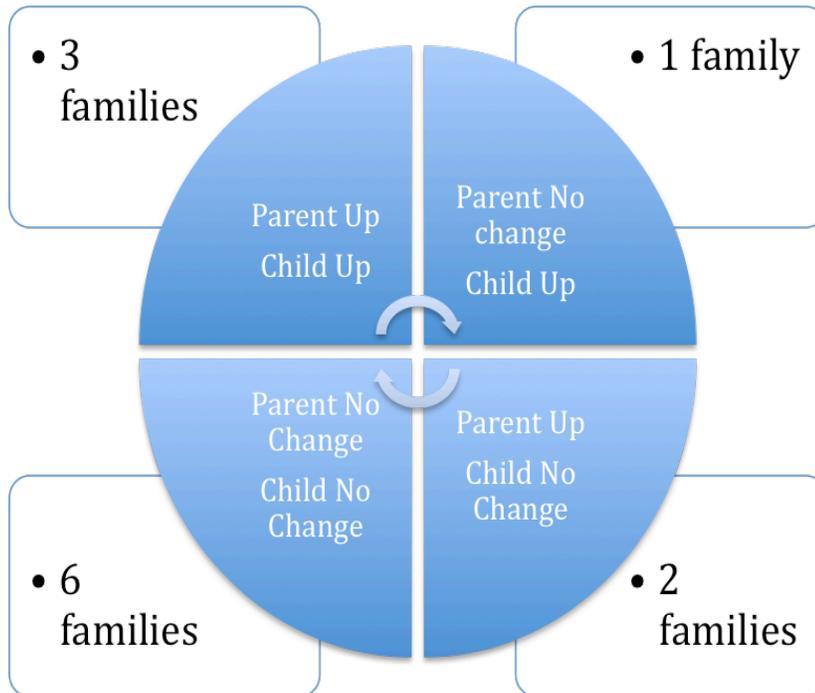


Figure 3. Parent-Child Talk Profiles (n=12)



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Appendix A. Clinician Evaluation of Parent Skills

Using the 7-point scale, for each family please select the number that best represents the Primary Caregiver's level of ability to implement the target skill. Please rate each Primary Caregiver engaged in the More Than Words (MTW) program individually (e.g. mom, dad, grandma, nanny). If you are unable to determine a rating for a skill (e.g. was not able to observe), please select 'N/A'.

Child Initials: \_\_\_\_\_

Caregiver: \_\_\_\_\_

<u>Stage of Communication</u>	Almost Never		Sometimes		Frequently		Consistently	
	1	2	3	4	5	6	7	N/A
-Successfully identifies the child's stage of communication (i.e., own agenda, requestor, early communicator, partner)								
<u>Give a Reason than Wait</u>	Almost Never		Sometimes		Frequently		Consistently	
	1	2	3	4	5	6	7	N/A
-Successfully implements MTW strategy: 'give a reason to communicate and wait' -Demonstrates by: waiting expectantly for initiations or responses								
<u>Be Face to Face</u>	Almost Never		Sometimes		Frequently		Consistently	
	1	2	3	4	5	6	7	N/A
-Adjusts body position to be at the physical level of the child -Brings objects to eye level								
<u>Join In and Play</u>	Almost Never		Sometimes		Frequently		Consistently	
	1	2	3	4	5	6	7	N/A
-Playing without dominating -Use of intrude strategy to create opportunities for language								
<u>Include Interest; Follow the Child's Lead</u>	Almost Never		Sometimes		Frequently		Consistently	
	1	2	3	4	5	6	7	N/A
-Demonstrates use of MTW strategy: 'OWL' - Observe, Wait, Listen								

<u>Imitate</u> -Imitates child vocalizations/words	Almost Never 1	2	Sometimes 3	4	Frequently 5	6	Consistently 7	N/A
<u>Interpret</u> Talk about what the child is doing while they do it. Interpret something that the child has said (i.e. child says ah while looking at a ball. You say "ball").	Almost Never 1	2	Sometimes 3	4	Frequently 5	6	Consistently 7	N/A
<u>Intrude</u> Adult is persistent and creative about joining in the play.	Almost Never 1	2	Sometimes 3	4	Frequently 5	6	Consistently 7	N/A
<u>Repeats key actions, words and/or phrases during an activity</u> Picks a target word or words that is repeated in an activity	Almost Never 1	2	Sometimes 3	4	Frequently 5	6	Consistently 7	N/A
<u>Objective</u> Decides what the goal is for the child What do you want the child to do?	Almost Never 1	2	Sometimes 3	4	Frequently 5	6	Consistently 7	N/A
<u>Uses Explicit Cues when needed</u> Physical prompt : hand over hand Physical and speaking models Speaking instructions Partial models.	Almost Never 1	2	Sometimes 3	4	Frequently 5	6	Consistently 7	N/A
<u>Uses Natural Cues when needed</u> Go slow Fill in the blanks Asking questions Hints	Almost Never 1	2	Sometimes 3	4	Frequently 5	6	Consistently 7	N/A
<u>Keep it fun!</u> The parent appears to be enjoying the interaction with his or her child. Parent uses fun words,	Almost Never 1	2	Sometimes 3	4	Frequently 5	6	Consistently 7	N/A

high affect (when needed), Modulated voice								
<u>Child Engagement</u> -Holds child's attention in an activity or routine that they have targeted	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>Helps child to understand by:</u> Say less Slowing down Stressing certain words Showing – visual helper, pictures, gestures	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>People Games</u> -Demonstrates the ability to engage in a variety of people games with the child	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>Songs</u> -Demonstrates the ability to engage in a variety of songs with the child	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>Toy Play</u> -Demonstrates the ability to use a variety of toys	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>Books</u> -Demonstrates the ability to engage the child in a book	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>Use a Variety of Labels</u> -Uses variety of vocabulary by: repeating words, emphasizing key words, labeling, adjusts complexity of vocabulary for the level appropriate for the child.	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A

<u>Expand</u> -Repeats words and corrects grammar as necessary -Repeats vocalizations/words and adds on	Almost Never  1      2	Sometimes  3      4	Frequently  5      6	Consistently  7      N/A
<u>Level of Implementation Fidelity</u> -Overall ability to accurately implement the MTW strategies across routines with the child	Almost Never  1      2	Sometimes  3      4	Frequently  5      6	Consistently  7      N/A
<u>Maximizes communication opportunities offered within an activity.</u>	Almost Never  1      2	Sometimes  3      4	Frequently  5      6	Consistently  7      N/A
<u>Maintenance</u> The parent will be able to keep using the strategies correctly over time as the child changes and develops.	Almost Never  1      2	Sometimes  3      4	Frequently  5      6	Consistently  7      N/A

Appendix B. Parent Self-Evaluation Questionnaire

Dear Families,

Thank you for participating in our parent-child interaction study! As part of your last round of LENA measures we would like to find out how you feel about the strategies and skills that you learned in the Hanen More Than Words (MTW) program. Using the 7-point scale below, please select the number that best represents how you feel about the skill using:

- an "X" to show how you felt before MTW and
- a circle "O" to show how you feel about the skill now that you have finished MTW.

Please have each adult who participated in the More Than Words program (e.g. mom, dad, nanny) fill out a separate sheet for themselves. If you don't think that you can answer a question please mark it as 'N/A'. Please note that your answers will be kept strictly confidential. All identifiable information will be removed from the final report.

If you have any questions about any of the items on this questionnaire, please call Steph at [phone number]. Thank you!

Child Initials: \_\_\_\_\_

Caregiver: \_\_\_\_\_

<u>Stage of Communication</u>	Almost Never	Sometimes	Frequently	Consistently				
-I feel I can successfully identify my child's stage of communication (i.e., own agenda, requestor, early communicator, partner)	1	2	3	4	5	6	7	N/A
<u>Give a Reason than Wait</u>	Almost Never	Sometimes	Frequently	Consistently				
-I 'give my child a reason to communicate and wait'. I show this by waiting expectantly for my child to make the first move or for my child to respond to me.	1	2	3	4	5	6	7	N/A
<u>Be Face to Face</u>	Almost Never	Sometimes	Frequently	Consistently				
-I get down to my child's physical level by changing the way I sit or stand (e.g. lie on tummy) or I hold up toys to my eye level to help my child look at me.	1	2	3	4	5	6	7	N/A
<u>Join In and Play</u>	Almost Never	Sometimes	Frequently	Consistently				
-I join in when my child is playing with something and "intrude" to give my child a chance to ask me for something.	1	2	3	4	5	6	7	N/A

<p><u>Include Interests:</u> <u>Follow the Child's Lead</u> -I "OWL". I show this by observing what my child is doing, waiting for my child to respond and then listening to my child's response.</p>	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<p><u>Imitate</u> -I use opportunities to imitate my child's vocalizations or words.</p>	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<p><u>Interpret</u> -I talk about what my child is doing while he or she does it. (i.e. child says ah while looking at a ball. You say "ball").</p>	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<p><u>Intrude</u> -I am persistent and creative about joining in my child's play.</p>	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<p><u>Repeats</u> -I pick out a target word (goal) and repeat it throughout an activity or routine to help my child learn that word.</p>	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<p><u>Objective</u> -I decide what the goal is for my child during an activity or routine. (i.e. I know that I want my child to learn)</p>	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<p><u>Explicit Cues</u> -I know when my child needs some help and then provide the right level of help by giving him or her a "cue" (e.g. Physical prompt: hand over hand, model a word)</p>	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A

<u>Natural Cues</u> - I can use natural cues to help my child learn (e.g. go slow, fill in the blanks, ask questions, give hints)	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>Keep it fun!</u> I have fun when I interact with my child (e.g. use fun words, excited affect)	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>Child Engagement</u> -I can hold my child's attention in an activity or a routine that we have worked on.	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>Four S's</u> -I help my child learn by using the Four S's (Say less, go slow, stress certain words, show with visuals or gestures)	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>People Games</u> -I complete people games with my child (e.g. tickles, chase game)	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>Songs</u> -I complete short songs with my child (e.g. Twinkle twinkle)	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>Toy Play</u> -I can use toys to help my child learn.	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>Books</u> -I can use books to create opportunities for my child to learn.	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A
<u>Use a Variety of Labels</u> -I show my child a variety of words by: repeating words, emphasizing key words, labeling, adjusts complexity of vocabulary for the level appropriate for the child.	Almost Never	Sometimes	Frequently	Consistently				
	1	2	3	4	5	6	7	N/A

<u>Expand</u> I repeat my child's words/vocalizations and correct his or her grammar as necessary (i.e., add on language)	Almost Never 1	2	Sometimes 3	4	Frequently 5	6	Consistently 7	N/A
<u>Overall Comfort</u> -Overall, I comfortably and accurately use the majority of the strategies I learned in the MTW program and that I can use them across routines and activities with my child.	Almost Never 1	2	Sometimes 3	4	Frequently 5	6	Consistently 7	N/A
<u>Maximizing Communication</u> -Overall, I use many of the opportunities that come up during the day for my child to learn	Almost Never 1	2	Sometimes 3	4	Frequently 5	6	Consistently 7	N/A
<u>Over Time</u> -I will be able to keep using these strategies as my child grows and changes.	No 1	2	Maybe 3	4	Likely 5	6	Consistently 7	N/A

Comments

Please feel free to use the space below to provide any comments that you might have regarding your experience in the MTW program.

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You have now completed our questionnaire. Thank you for your feedback!