

## Studies in AAC and Autism: The Impact of LAMP as a Therapy Intervention

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### ABSTRACT

The seven children in this study, who ranged from age three to age seven, had a diagnosis of autism or pervasive developmental disorder-not otherwise specified (PDD-NOS) and *complex communication needs (CCN)*. All seven were diagnosed with expressive-receptive language disorder. Four presented with severe/profound apraxia. Two were found to have dysarthria of speech. Each obtained a speech generating device (SGD) and received Language Acquisition through Motor Planning (LAMP) therapeutic intervention. Each child demonstrated communication progress. Language samples from six participants revealed gains as measured by mean length of utterance (MLU) within the first year. Other progress was noted in areas such as enhanced receptive vocabulary, spontaneous use of language, natural vocalization, and in the reduction of difficult behaviors and increase in shared attention.

Many individuals with autism do not produce natural speech that is adequate to meet their daily needs (Weitz, Dexter, & Moore, 1997). The level of competence in communication has been found to be a predictor for positive outcomes for individuals with autism (Lord & Paul, 1997). This information has brought renewed focus upon the goal of assisting children with autism to develop useful speech (Department of Health & Human Services, 2004).

Recently, support for these communication deficits has often been sought from augmentative and alternative communication (AAC) systems, especially those which provide an auditory component, or speech-generating devices (SGDs) (Schlosser, et al., 2007).

Prizant & Wetherby (1993) found that nonverbal systems may actually facilitate speech acquisition in children with disabilities. Others have suggested that therapy employing SGDs could promote the production of speech (Frost & Bondy, 2002; Blischak, Lombardino, & Dyson, 2003).

The main thrust of interventions that employ AAC is to enhance the client's communication ability by means of the multi-modal capabilities inherent in AAC systems themselves: tactile interaction with visual symbols/devices and auditory feedback (Light, Beukelman, & Reichle, 2003). Providing a greater measure of communication competence, however alternative and augmented it may be, constitutes a major step forward for the child with autism. The prospect of the production of natural speech as a result of such interventions is the serendipitous ideal.

Millar, Light, & Schlosser (2006) performed a meta-analysis upon research on low-tech AAC interventions and speech production from 1975 to 2003. The participants in the studies that demonstrated the best analysis of evidence consisted mostly of individuals with autism or intellectual disability, but there was also a representation from other diagnoses. They found that speech development showed modest improvement in 89% of the participants. The remaining 11% demonstrated no change.

Schlosser & Wendt (2008) conducted a systematic review of the research regarding AAC and children with autism. Their results indicated no impediments to communication progress, and that some modest gains were evident in most of the studies. Ronski, et.al. (2010) conducted a randomized study of toddlers with developmental delays and with spoken vocabularies of fewer than ten words. The use of AAC in therapy and at home was found to enhance the vocal ability of the children in the study.

The introduction and acquisition of an AAC system is one aspect of the intervention. Another aspect relates to *how* the SGD is used with the client. Since the research incorporated studies that used diverse strategies for the intervention, no findings were reported on how AAC systems might best be implemented in interventions. This study examines a set of individuals with whom the Language Acquisition through Motor Planning (LAMP) approach to implementing an AAC device as an intervention was used.

### *Language Acquisition through Motor Planning (LAMP)*

Language Acquisition through Motor Planning (LAMP) is a therapeutic approach based on neurological and motor learning principles. The goal is to give individuals who are nonverbal or have limited verbal abilities a method of independently and spontaneously expressing themselves in any setting. LAMP focuses on giving the individual independent access to vocabulary on voice output AAC devices that use consistent motor plans for accessing vocabulary. Teaching of the vocabulary happens across environments, with multisensory input to enhance meaning. The child's interests and desires help determine the vocabulary to be taught.

The LAMP approach involves five basic components: (1) Readiness to Learn, (2) Shared Engagement, (3) Consistent Motor Patterns, (4) Auditory Signals, and (5) Natural Consequences. Together these components work to achieve language connections that include the growth of vocabulary, extension of language meaning, and generalization of words & concepts to other contexts.

*Readiness to Learn.* Children with autism often demonstrate sensory integration issues. Oversensitivity as well as defensiveness can impede therapy and communication (Kranowitz, 2005). Each person on the autism spectrum is unique and will demonstrate differences in the manner in which they process and respond to sensory input. Any therapy approach with these individuals must consider and address these differences.

*Shared Engagement.* Studies have indicated correlations between time invested in shared engagement and language development. (Tomasello and Farrar, 1986; Smith et al., 1988; Carpenter et al. 1998; Markus et al. 2000; Morales et al. 2000; Adamson, Bakeman, and Decker, 2004). Blischak (2003), Ronski & Sevcik (1996), and Smith & Grove (2003) observed that interactions in AAC therapies, especially those involving SGDs, are by nature a shared experience. The opportunity to model good communication is facilitated by the structure of the setting.

The LAMP approach involves giving the child the opportunity to initiate activity and communication. It refers to presenting relevant vocabulary that is motivating to the child and allows the child to make choices and comments and to ask questions. Lewy and Dawson (1992) revealed that children with autism and Down syndrome, as well as typically developing children, responded with greater attention during child-centered activities than to adult-centered activities. The LAMP approach seeks to maximize motivation and language learning by engaging the learner in communication around activities of their choosing and to engage them in communication which goes beyond simple “show-me-the-object” interactions.

*Auditory Signals.* Using an SGD in this process allows for two supportive features: (1) added sensory input and (2) multisensory convergence. The auditory output of the SGD provides additional sensory input by which the client might derive meaning from the interaction. Multisensory convergence refers to the pairing of a unique and consistent motor plan with a consistent auditory output. Connections such as these are part of our natural speech. The particular relationship between a specific motor movement and the associated sound helps distinguish one sound from another. Schroeder, et al. (2003) discovered that in the initial stages of auditory cortical processing, inputs from our visual, auditory, and somatosensory faculties converge. The timing of this convergence is the key to successful integration and optimal interpretation of sounds we hear.

Romski & Sevcik (1988, 1993) and Schepis, Reid, & Behrman (1996) have suggested that the production of speech output by the SGD may contribute to learning and communication. The opportunity to present additional sensory input by means of the SGD offers a significant advantage because the child hears the word immediately after the execution of a specific motor sequence. This can be specifically reinforced through the presentation of natural consequences aimed at enhancing understanding of the selected word.

The LAMP process seeks to focus on words that are powerful and likely to be used and encountered in multiple contexts. Wilson (2004) posited that humans use the same neural infrastructure when we speak and when we are listening. LAMP intends to maximize the impact on language learning by emphasizing words that have been identified as “core” vocabulary (Cross, Baker, Klotz, & Badman, 1997). Since these are the words most commonly spoken, they are likely to be encountered repeatedly by AAC users.

*Natural Consequences.* Miranda (2003) suggested that immediate feedback provided in AAC therapies contributed to speech development. The association of the motor movements required to select an icon or a sign with the real object or action in the environment provides a reinforcing effect. The LAMP approach seeks to pair the motor pattern with consequences that have social impact as well as multisensory involvement of an auditory, visual, or tactile nature.

When the user activates the SGD a sound is produced. There is one unique sound for each motor pattern. In the LAMP approach, the communication partner seeks to extend the language learning by providing animated reactions, producing the requested item or activity, or supplying other responses that further enhance the meaning of the communication. By keeping the interests of the user in mind, the communication partner can select motivating, engaging activities that will maintain the attention of the user for longer periods. Pairing a multisensory visual/motor

response with the word can be of great assistance where there are auditory processing issues. Language learning can be enhanced when the user can integrate motor input (accessing the SGD), auditory signals (speech from the SGD), and visual signals (observing the natural consequences).

*Consistent Motor Patterns.* According to Levelt (1989), typically developing individuals produce speech without consciously addressing the processes of encoding or articulation. It is a process that is automatic. For users of AAC to become effective, a similar automaticity must be achieved: one by which the user does not dwell on the location or meaning of symbols, nor contemplate the sequence of movements necessary to activate them.

The development of such automatic operation of an SGD comes through practice of established motor movements related to unique words/expressions. These motor patterns should remain consistent. It would be counterproductive to change a pattern once it has been learned. Thus the LAMP process emphasizes consistency of motor patterns.

This challenge was observed by Porter and Cafiero (2009) who contended that employing an organizational pattern for an AAC system that uses fluid and changing patterns requires the user to devote energy and focus to visual interpretation of icon choices instead of attention to the content of conversation. As the user achieves automaticity, they devote less energy into how a thought will be expressed, and produce the thought with less effort and greater speed.

### *Methodology*

Seven children, four boys and three girls between the ages of three and seven, with diagnoses of autism spectrum disorder (ASD) or PDD-NOS were clients in a private practice setting. All of the parents were concerned about their child's communication development. They brought their child with the stated objective that their child's communication deficits would be addressed. Every child was given a speech-language evaluation upon the commencement of service. Baseline data on communication ability was taken.

It was clear from observation and from baseline data collected that each participant had complex communication needs (CCN). Specifically, each child produced very limited vocalizations with low intelligibility, and possessed severely limited expressive vocabulary. In addition, each child demonstrated difficult behaviors and an inability to maintain attention to tasks. The speech-language pathologist (SLP) believed that AAC intervention was warranted in each case.

Each child was given an AAC evaluation and trialed multiple devices for extended periods (two to six months). The SLP recommended a device for each child. Funding was obtained for each device based upon each child's eligibility for Medicaid and private insurance or grant funding.

Language Acquisition through Motor Planning (LAMP) was identified as the therapeutic approach best suited for each of these subjects. The device selected as most appropriate in each client's case was the Vantage Lite from Prentke-Romich Company. The Vantage Lite was selected for its size and weight, its durability, and because it contains the Unity language system.

Unity features a research-derived core vocabulary, and maintains consistent location of the symbols. For example, the symbol representing the word “eat” is always in the same position. This provides the opportunity develop an automatic motor movement to access the word, which minimizes both the cognitive and visual tasks of finding the symbol. Subjects were introduced to core words in the Unity language system by a process where only a few words were initially available. More words were added gradually as the subjects demonstrated mastery of the current words. Once the device was delivered, LAMP therapy was initiated.

LAMP therapy with the SGD involved one to three sessions per week with the private practice SLP, depending upon the subjects’ family schedules. Training was provided to families in the LAMP approach with the expectation that the family would support the LAMP approach at home as well. The level of support at home and at school varied from child to child.

The primary measure of gains in communication for this study was mean length of utterance (MLU). The Systematic Analysis of Language Transcripts (*SALT*) was applied to language samples taken from subjects at various intervals. Data collected was matched to Brown’s Stages to provide a frame of reference for therapy and to help identify progress.

In addition, instruments such as the Preschool Language Scale, Fourth Edition (PLS-4) (Zimmerman, Steiner, & Pond, 2002) were used where possible to measure aspects of expressive and receptive language. Type-token ratio (TTR) was used in selected cases as a measure of vocabulary diversity within a child’s speech. Anecdotal data was collected on each subject. Data collection throughout this study was complicated by the subjects’ difficult behaviors and their low tolerance for the testing environment. Data was supplemented from parent reports and informal measures.

Understanding that problem behavior can be a form of communication, (Carr, et al., 1994; Donnellan, Miranda, Mesaros, & Fassbender, 1984; Durand, 1990; Reichle & Wacker, 1993), the therapist in this study sought to collect informal data on behavior as well as upon attention and focus. Parents were encouraged to contribute narratives of these aspects as well.

### *Results*

It was clear from therapy observation, notes, and from parent reports that all seven participants demonstrated communication progress. A series of tests were conducted at various intervals to assess progress. Testing revolved around each child’s health issues, and family and practitioner schedules. Progress was compared to baseline performance and previous test data. Results for each child are posted in the Appendix.

To the degree that performance could be measured, it was apparent that each child made gains in both expressive and receptive language. However, each demonstrated different levels of progress. Among those who made the most progress, vocabulary expanded and represented broad lexical variation. The most telling results were evident when mean length of utterance (MLU) was assessed by applying the *SALT* to language Samples. Data was plotted on charts for graphical analysis where possible. All clients showed progress.

Bianca, age five, initially spoke no words but used a few signs along with gestures and pointing. She was prone to fits of kicking, hitting and throwing things. Once she got her SGD and began LAMP intervention she progressed rapidly. Her MLU went from ~1.0 to 5.59 over a 24 month period (see figure 1). Her focus and attention improved along with her communication. After she had increased expressive language skills through the use of her SGD, she began to vocalize more often. However, structural abnormality (i.e., paralyzed vocal cords and laryngeal weakness), severely limited her ability. To support her vocalization, therapy shifted to incorporate voicing therapy to increase respiratory support for sustained vocal production. Due to limited respiratory support at the outset, she was able to vocalize audibly for <1 to 1 second for vowels sounds only. When the data for this report was being finalized, she was voicing to produce some consonants and consonant plus vowels combinations. Bianca was able to begin producing audible words, although she still relied on her SGD. Her vocabulary went from ~50 words to ~ 500 words during that two-year period.

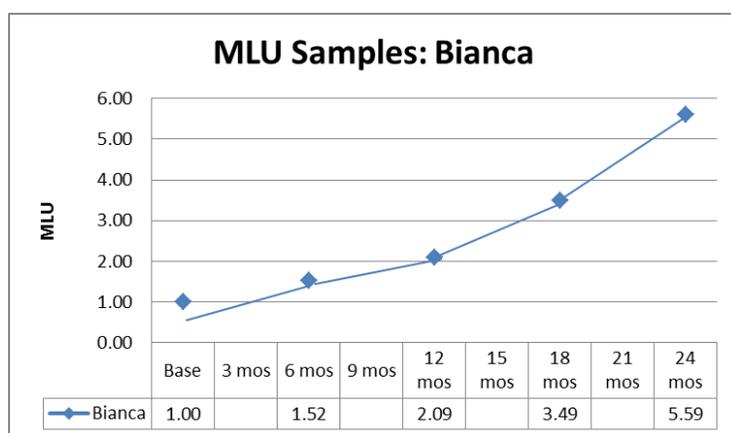


Figure 1. Data plots for MLU Progress on Bianca.

Before Terry, age four, began using an AAC device, his most common forms of communication were screaming, biting, kicking and running away. He was physically aggressive and sometimes self-injurious. He was reported to have a 30 word vocabulary, but was seldom observed to use it. Within one year of starting LAMP and using his SGD, Terry's MLU was measured at 2.34 (see figure 2) and his vocabulary had grown to 126 words when using his communication device. Though his intelligibility was low, he began spontaneously verbalizing and began using his device in a back-up role. When he had trouble pronouncing a word, he would often find it on his device, have the device speak it, and then say it himself. During the first 12 months of LAMP therapy there was an observed increase in shared engagement and a marked decrease in behavioral outbursts. After two years of therapy Terry's MLU fell to 1.25. While still indicative of progress over baseline measures, this sample coincided with a time of added family stress and reduced participation in therapy. Terry also changed schools at this time. The new school environment was less supportive of use of the device in daily activities. In the final few months of the study, the SLP provided therapy services in the home in the hope of maintaining communication gains. She found that setting full of distraction for Terry. In the last 6 months of this study, Terry's use of his device, the carryover of LAMP-trained vocabulary from session to

session, and verbal speech intelligibility all decreased while his behavioral outbursts (kicking, scratching, screaming, running, hitting) began to increase.

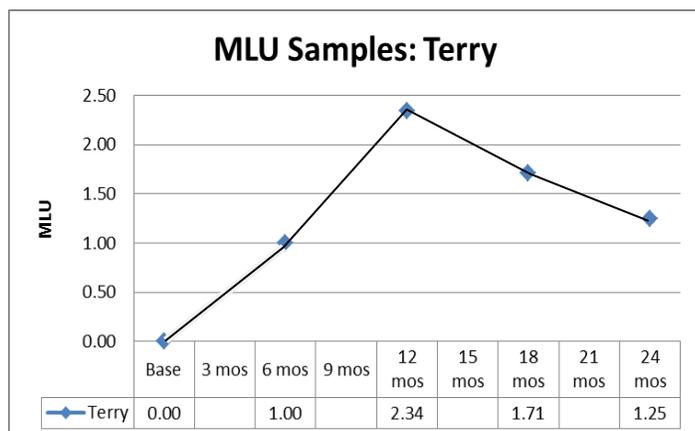


Figure 2. Data plots for MLU Progress on Terry.

Traditional speech therapy did not result in satisfactory progress for Haylie, age 7. She began with a set of one to two word phrases that appeared to be pre-trained, echolalic, or drilled phrases. She was easily distracted and would fixate on items or tasks for extended periods. She was prone to outbursts when she encountered challenging tasks. Once she began using her SGD and receiving LAMP therapy, Haylie rarely demonstrated fixation or these disruptive behaviors. Her MLU went from ~1.0 to 2.43 (see figure 3). Her language became less rote and more novel and interactive. Her syntax and vocabulary usage became more diverse as reflected in her Type-Token Ratio which went from 39% to 66% over 24 months. As therapy went on she began to attempt more frequent vocalizations apart from her SGD.

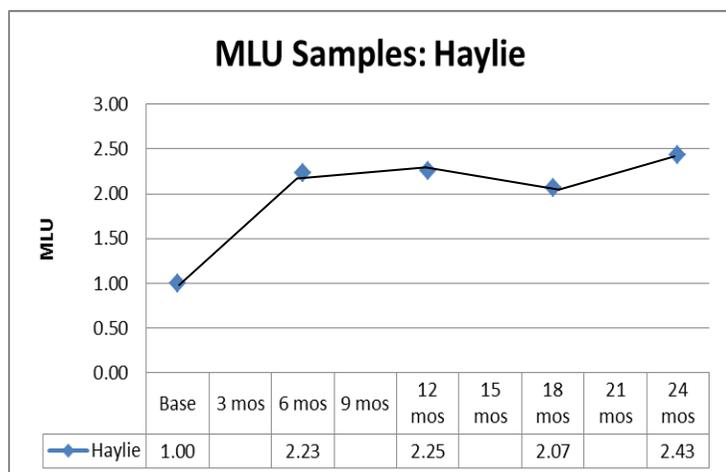


Figure 3. Data plots for MLU Progress on Haylie.

At three years of age, Cody exhibited no verbal communication. He was easily frustrated and subject to frequent meltdowns. His distractibility made testing difficult. He initially struggled with a low-tech communication board but progressed quickly when introduced to his SGD and the commencement of LAMP therapy. His MLU went from 0 to 1.39 (see figure 4) over 30 months. His exploration of the device and mastery of operational competence were noteworthy. He figured out how to get into the Vantage Lite control panel and “unhide” words in his core vocabulary. Cody showed progress in shared engagement over time and his behaviors improved as well. In his second year, Cody began to attempt to verbalize spontaneously. His intelligibility was low, but his motivation to try to speak was quite high. Analysis of later language samples revealed MLUs of 1.56 and 1.39. The clinician’s notes indicate that Cody was particularly difficult to work with on those specific days and that the results may not be accurate indicators of progress. Nevertheless, Cody had made significant sustained progress.

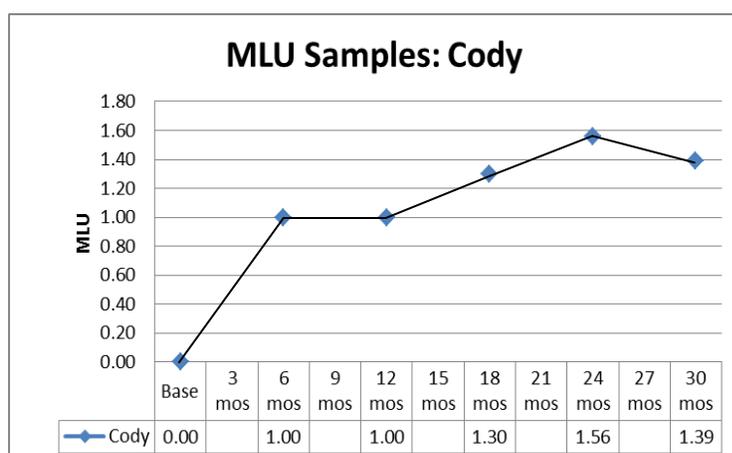


Figure 4. Data plots for MLU Progress on Cody

John, age three, began therapy with no words and relied upon pointing, gestures and screaming to communicate. He was very aggressive and easily frustrated. His attention span was less than a minute. Within six months of the arrival of his SGD and the initiation of LAMP therapy, John would attend for fifteen minutes at a time. His use of the AAC device boosted his MLU from >1.0 to 1.39 in the first year (see figure 5). Also worth noting is that the twelve month sample was taken shortly after the changes in the software versions on the SGD had been made. This required him to re-learn the motor patterns for all previously trained vocabulary words and resulted in less new vocabulary learning. Subsequent language samples revealed an increase to 1.5. These last two samples were taken concurrent with the onset of seizure activity that had emerged unexpectedly. It appeared that short term memory was being affected.

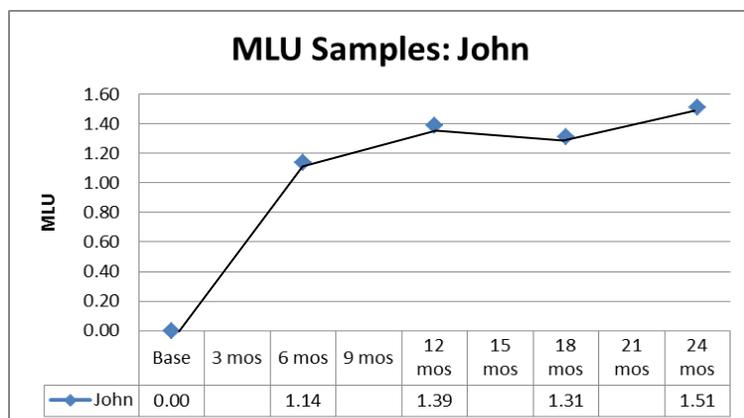


Figure 5. Data plots for MLU Progress on John.

Zoe, age six, was very limited in her vocalizations and was difficult to understand. She primarily communicated by gestures and by physically leading adults to what she wanted. She required significant time during each therapy session to get calmed down and shared focus was rare. She began with a low-tech board but had to be prompted and cued for almost all interactions. Within two weeks of starting LAMP and receiving her SGD, Zoe was using the AAC device spontaneously. She began using possessive forms on her device after seven weeks. Her behavior became markedly more compliant and her shared attention extended to about ten minutes at a time. Her MLU went from  $>1.0$  to 1.68 after eighteen months (see figure 6). After about six months of using her SGD, Zoe began to spontaneously imitate the words produced by her device.

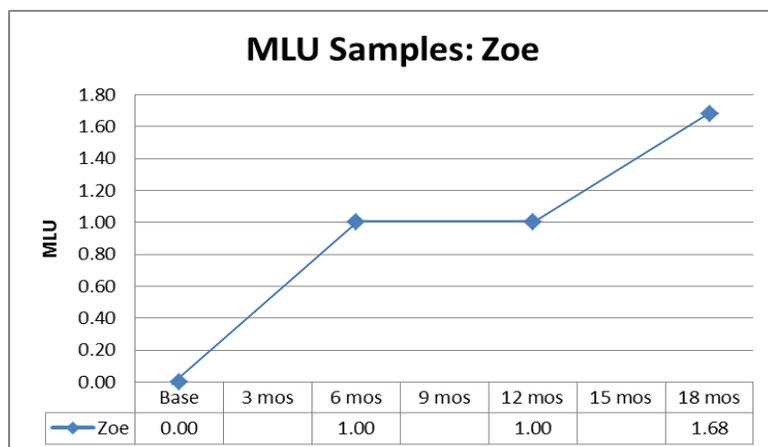


Figure 6. Data plots for MLU Progress on Zoe.

The remaining participant in this study was six year old Trent. He initially demonstrated evasive and disruptive behaviors and an inability to pay attention for any meaningful period. It was difficult to collect data for this participant throughout the study due to these factors. Nonetheless, he has demonstrated some communication progress. Trent had initially tried a low-tech communication board with very limited results. His SLP had been pairing single paper icons with highly motivating activities which had resulted in hand-over-hand prompting and little initiation. One day the SLP affixed each of the icons “go” and “eat” to a BigMack and recorded

the single word that went with the icon. After hearing the auditory output and having the natural consequence of receiving the request, the child spontaneously selected the switch 46 times during that one session. Following that, the LAMP approach was incorporated using a low-tech communication device. Trent quickly acquired several words. The application for funding for a speech generating device was initiated so that he would have a device that would offer an appropriate number of vocabulary words for him to continue to learn more communication without having to relearn the motor sequences to access each individual word. While Trent continued to have compliance issues, his frustration level reportedly dropped as he demonstrated greater independence. He progressed from zero words in use to 102 words with the use of his SGD in a 24 month period. However, because of the difficulty in collecting data for Trent, no sampling of MLU data is presented here.

In summary, seven children with CCN were provided with an SGD and LAMP therapy over a period of 18 to 30 months. Attention was given to MLU, expressive and receptive language ability, and vocabulary. Changes in behavior and attention were also noted. What follows is a discussion of the issues relating to validity and the conclusions and observations that can be made from this study.

### *Validity and Treatment Integrity*

The data used in these studies was taken from the notes and testing collected as part of the therapist's application of evidence based practice (EBP) with these clients (Schlosser & Raghavendra, 2004). While this study does not conform to experimental design principles, the therapist has attempted to apply principles of single subject research design to her EBP, particularly in the structure of the intervention and the collection of data. (Satterfield & Anderson, 2009).

Schlosser (2002) has identified treatment integrity as a major challenge to effective EBP. The LAMP treatment provides a well-defined protocol. The therapist has documented in the notes that care was taken to follow the suggested protocol. Obstacles and deviations were noted. These are reflected in the Appendix in the notes relating to each participant.

There are many external threats to validity. In such studies, the unique characteristics of each participant and the diversity of family life, school, and extracurricular activities introduce many sources of variance. While the design of this study cannot mitigate the influences of these factors, they can be identified. These have been catalogued in the appendix notes for each participant. Where external influences have been observed in this study, the impacts have been noted.

### *Conclusions*

A combination of objective and descriptive data indicates that these seven participants in this study demonstrated an improvement in communication. Although progress varied from child to child, some commonalities may be discerned. The MLU for each of the participants - who could be measured - did increase. The size of the vocabulary used by each subject increased. Six of the seven used the SGD to spontaneously generate communication. All seven used the AAC device

to respond to questions and to make choices. Four subjects have demonstrated some level of natural vocalization in addition to using the SGD for communication. Two of the four had very limited vocalization at baseline, and their vocalization increased notably while using their AAC devices.

Several observations can be made about changes in behavior and attention in these studies. All participants demonstrated gains in shared engagement and attention and a reduction in problem behavior were observed. Three of the participants, however, did not sustain continued progress in these areas late in the study. While not specifically studied, these trends were observed to occur at the same time as the emergence of medical issues and changes in environment and family setting. These particular results may be linked to those changes.

The following specific observations can be made about this study:

1. *The LAMP therapy approach appears to have been important in each student's communication progress.* In this study one single, defined, consistent approach to therapy was used with each child. While individualized to address the needs of each child, the therapy was applied in each case in a manner consistent with the principles described in this article. To be sure, there were many other factors going on in the lives of each of the participants. Individual therapies for each child are listed in the Appendix beneath each set of data. However, each child's extracurricular activities were different. It would appear that the singular common thread of LAMP would point to this therapy approach as being a central factor in their communication progress. It is the only influence present with the specific intent of producing the effects observed.
2. *The LAMP technique appears to have contributed to the participants' gains in terms of behavior and attention.* From anecdotal and informally collected data, it appeared that difficult behaviors were reduced in each case as the LAMP approach continued. In addition, periods of time in which participants were able to pay consistent attention and establish shared engagement lengthened as therapy progressed. As noted above those children whose performance in these areas was variable were also observed to have encountered medical and personal issues that may have accounted for the observed differences.
3. *The Vantage Lite with Unity vocabulary appears to support the LAMP therapy effectively.* The Vantage Lite was selected as the SGD for the children in this study because it was durable, light weight, and portable. However, the success of the LAMP approach depends upon the SGD to support two factors, namely: consistent motor patterns and auditory signals. While many dynamic display devices could produce auditory signals in a satisfactory manner, it is clear that the organization of the language on the Vantage Lite is a critical factor. The Unity language system is organized around a core vocabulary. The construct of the Unity core page results in fixed locations for the symbols that represent the vocabulary. The net result for the child using the Vantage Lite and Unity vocabulary is that the motor plan for each word is fixed and does not change, which provides an opportunity to develop motor automaticity for communication.

There are some observed effects produced during this study that warrant further study:

1. *What is the impact of the LAMP therapy on those who exhibited natural vocalization?* It is remarkable that natural speech might emerge in children who were not speaking previously. While not a stated goal of the LAMP approach, all of the children in this study improved their ability to produce natural speech while using their SGD. Four of the children made remarkable progress. What accounts for this progress? Does the use of an SGD serve to model speech for the child? Is the LAMP intervention an effective method for making connections described by Wilson (2004) and by Schroeder, et al. (2003)? These questions deserve further study.
2. *Will the children who began to naturally vocalize ultimately transition to natural speech and no longer need an AAC device?* This study addresses only the initial years of intervention. Of those who have begun to naturally vocalize, how independent will they become with their natural voices? What will be the role of the SGD in their approach to communication going forward?
3. *What was the impact of family and school support for LAMP therapy upon client progress?* This study focused primarily upon participant progress as it related to interactions with the speech-language pathologist. While the value of family and school support for therapy interventions is assumed, it may be instructive to examine how such support influences client progress.

This collection single subject studies provides clear indication that, for this group of individuals with autism and PDD-NOS with complex communication needs, communication gains may emerge from using an SGD along with a defined, consistent therapy method. The LAMP method appears to be the major factor in the gains seen in communication as well as those in the areas of behavior and shared engagement. The Vantage Lite with its Unity language system provides an optimum environment in which to conduct LAMP therapy.

## Appendix - Individual Data

**BIANCA**

Age 5

Female

Medical DX: Autism, Developmental Delay, Mental Retardation, Dysarthria, s/p Tracheostomy

Treatment DX: Dysarthria of Speech; Moderate Receptive-Profound Expressive Language Disorder

SR	Baseline	6 Mos	12 Mos	18 Mos	24 Mos
<b>Date</b>	6/24/09	1/4/2010	7/6/2010	1/3/2011	8/16/2011
<b>Intervention</b>	VTL 84 1-hit + LAMP*	VTL 84 Full + LAMP*	VTL 84 Full + LAMP*	VTL 84 Full + LAMP*	VTL 84 Full + LAMP*
<b>MLU</b>	1	1.52	2.09	3.49	5.59
<b>Brown</b>	Early Stage 1	Stage 1 (Emerg 2)	Stage 2	Early Stage 4	Post Stage 5
<b>Expressive (PLS-4) AE</b>	11 mo	12-18 mo	21-35 mo (ID)	28-45 mo (ID)	41+mo
<b>Receptive(PLS-4) AE</b>	3.5 yr	3.5-4.0 yr	5.9 yr.	5.7 - 6.3 yr (ID)	6-7 years
<b>Vocab (words)</b>	<50 (PR) mostly nouns	104	150	250-300	300-500
<b>Other Communication</b>	pointing, gesturing & using some ASL	25 ASL	25 ASL	25 ASL	25 ASL
<b>Vocalization</b>	0 (trach) non-functional noises	poor intelligibility of single words	poor intelligibility of single words, improving w/ respiratory support for audible voice production	Approximations of consonant phonemes in the initial position of words. Intermittently understood	Her speech and voice production yield poor-good intelligibility of single phonemes. Vowels and bilabials are produced with fair-good intelligibility. Family understands 50%
<b>Attention</b>	<1 min span	Still easily distracted Joint attn up to 15 min	Good eye contact Longer atten. w/ moderate cues	Improved attention during activities of high-interest	Continued improving attention. Communicating more readily using this sequence of application of skills: 1) sign language, 2) verbal approximation, 3) use of SGD to clarify and expand communication significantly. Cues needed to provide detailed communication with partners.
<b>Behavior</b>	kicking, hitting, throwing things	impulsive & very distractible if sensory and behav mods not implemented	will sit at a table to complete structured activities w/ sensory-based support Frequently distracted.	Motivated to communicate in structured activities that she enjoys	Require "set up" to use SGD during social interactions. Notable decrease in undesirable behaviors when she is able to communicate via SGD.
<b>Comments</b>	Not yet using SGD. All training done on trial devices used during evaluation periods. Then while awaiting child's recommended device, intervention was completed using an 84 location manual board simulating training for sequenced	Uses the device for rote communicative activities (i.e., saying the pledge of allegiance, telling jokes, singing songs), is using the device to communicate humor through jokes and games (i.e., Simon Says)	Strength continues to be receptive language. Child motivated to use SGD during therapy sessions and at home.	During receptive language assessment, the child's lack of expressive skills greatly affected her ability to communicate her receptive knowledge of some higher level language concepts. Child is communicating "not" on SGD to tell	She is able to use pronouns, present progressive verbs, adjectives, nouns, verbs, plurals, possession, comparatives, and vocatives with little to no prompting. Still needs strategies for strategic competence.

	vocabulary system.			others that she does not know the location of her intended word on her SGD.	Child starting to attempt to spell words on device, using spell prediction and icon tutor to find intended words on SGD. Also starting to use punctuation of "." And "?" appropriately on SGD.
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\* Other therapies incl:  
 Behavior Therapy , OT/PT, Gymnastics/baseball ,  
 Community Activ

(PR) Parent Report

(ID) Informal data was collected

Note: Bianca has a private duty nurse that travels with her all day while parents are at work. The nurses are trained by the family regarding the interventions that are being implemented during private therapies. The nurses were also trained during private therapy sessions. Since they accompany Bianca to school all day, they are able to prompt and cue her when needed and to support the use of the device somewhat in the school environment.

**TERRY**      Age 4      Male

Medical DX: Autism, Apraxia of Speech

Treatment DX: Severe Apraxia of Speech; Moderate Receptive-Profound Expressive Language Disorder

	<b>Baseline</b>	<b>6 Mos</b>	<b>12 Mos</b>	<b>18 Mos</b>	<b>24 Mos</b>
<b>Date</b>	6/25/09	12/28/2009	7/1/2010	1/11/2011	7/25/2011
<b>Intervention</b>	Unity 84 transitrn man. Board w/ ALgS	Received SGD 8/09. VTL 84 Full + LAMP 2 hours/week	VTL 84 Full + LAMP* 2-hrs /week	VTL 84 Full + LAMP* 1-hrs /week	VTL 84 Full + LAMP* 1-hrs /week
<b>MLU</b>	<1.0	1.0	2.34	1.71	1.25
<b>Brown</b>	Stage 1	Stage 1	Early Stage 2	Stage 1	Stage 1
<b>Expressive (PLS-4) AE</b>	AE: 1.8	24 mos	24-30 mos	24-30 mos	24-30 mos
<b>Receptive(PLS-4) AE</b>	AE: 2.2	3 years	4-5 yrs. (ID)	4-5 yrs. (ID)	150-175
<b>Vocab (words)</b>	30 words	50 words	126 (AAC)	175 (AAC)	Verbal at single words
<b>Other Communication</b>	scream, grab, bite, kick, run away & yell	Verbalizations are emerging.	Verbalizations emerging	Verbalizations emerging	Single word verbalizations.
<b>Vocalization</b>	10% intellig for non-familiar; 50% intellig for family	Says approximations of 20 words.	intelligibility is 70% with context known	intelligibility is 70% with context known	60% intelligible with the context known.
<b>Attention</b>	Difficulty attending - unable to complete eval	Increased attention.		Very distracted in home setting hard to orient to therapy	Easily distracted.
<b>Behavior</b>	physically aggressive (scratching, hitting, screaming)	Decreased behavioral outbursts.	Behavioral outbursts have dramatically lessened	Outbursts continue at lower levels	Increased behavioral outbursts.
<b>Comments</b>	Sensory related behaviors: sensitivity to light and sound. Impulsive and very distractible without sensory modifications.	Starting to vocalize while selecting words on SGD.	Spontaneously verbalizes in phrases, although intellig. is still poor at this time, as his primary method of communication. He uses his speech generating device as a back-up communication system	spontaneously verbalize an approximation of the word when he selects it on his speech generating device	Child able to locate 150 sight words (when shown written word only) on SGD without cues.

(PR) Parent Report

(ID) Informal Data

**HAYLIE**                      Age 7                      Female

Medical DX: PDD-NOS, Sensory Integration Dysfunction, ITP, Global Developmental Delay, Myopia

Treatment DX: Mixed Receptive –Expressive Language Disorder

	<b>Baseline</b>	<b>6 Mos</b>	<b>12 Mos</b>	<b>18 Mos</b>	<b>24 Mos</b>
<b>Date</b>	1/8/10	7/15/2010	11/29/2010	6/11/2011	1/30/12
<b>Intervention</b>	Core word approach Model vocalizations 1X Wk	Core word approach Model vocalizations 1X Wk	August 2010 VTL limited exp. Core LAMP * 1X Wk	VTL limited exp. Core LAMP * 1X Wk	VTL limited exp. Core LAMP * 1X Wk
<b>MLU</b>	1.0 verbal	2.23	2.25	2.07	2.43
<b>Brown</b>	Early Stage 1	Stage 2	Stage 2	Stage 2	Stage 2
<b>Expressive (PLS-4) AE</b>	N/A TTR= 39% (46/61)	N/A TTR: 39% (46/61)	21-35 mos. TTR= 34% (45/133)	21-35 mos. TTR= 52% (70/135)	21-35 months TTR: 66% (83/125)
<b>Receptive(PLS-4) AE</b>	2.6 yrs	3 years	4 yrs (inferred)	4.0-4.5 yrs (inferred)	4.5-5 yrs (inferred)
<b>Vocab (words)</b>	50 - 60 w/ out prompt	<75	100	150	200+
<b>Other Communication</b>	25 Pic Sym	25 Pic Sym	Eye contact, physical leading to desired item or activity (mom only).	Eye Contact, physical leading.	Sustained eye contact, increased social touch to request attention from others.
<b>Vocalization</b>	primarily communicates using 1 word utterances w/ occasional phrase 90% intelligible at the single word level - echolalia, delayed echolalia, or pre-trained/ drilled phrases	Produces verbal imitations of 4 verbs 2-4 adjs now verbalizing 2-4 word utterances several times a day	Able to vocalize w/ low volume, better intelligibility The following additional semantic relations have emerged since last eval: Nonexistence, Action+Agent, Agent+Object, Recurrence, Entity+Attributive, Noun+ Noun.	Verbal language is signif. less echolalic & rote and is more novel and generative in individual unique interactions. Since last eval has demonstrated use of the following additional semantic relations: pronoun + adjective+ adjective, Question/locative+ vocative, Verb+ noun, verb+possessive+noun, and adverb+adjective	Vocalizing now at 2-3 words phrases. Words that are trained via LAMP on SGD are heard verbally by child in the following several weeks if word is especially meaningful to the child for a desired activity or item.
<b>Attention</b>	Would not attend to stimuli / distractible. Fixation on items/tasks, biting her shirt, and pulling on her shirt. crying, attempting to get up from her chair, and turning her head from stimuli	Fair eye contact. Maintains attention for 10-15 mins w/out behav outbursts	Can sit at a table and attend to structured and unstructured activities for 45-50 minutes without an extended break	Can sit at a table and attend to structured and unstructured activities for 45-50 minutes without an extended break	Continues to have improved attention and also improved social interactions using communication.
<b>Behavior</b>	Occasional outbursts when encounter challenging demands or chg routines. Distractible when too much is going on...	Her behavioral outbursts do not exceed crying, attempting to get up from her chair, biting her shirt and turning her head from stimuli. She was not aggressive and did not engage in self injurious behaviors.	At times she does become slightly frustrated and usually will bite her shirt if this happens, but is redirected without much effort or time lost.	At times she does become slightly frustrated but will grunt or put her hands down on the chair and tense her body for a few seconds. She rarely bites her shirt anymore during these periods of frustration	Initiating communication with familiar partners, using more eye contact to confirm communication message.

<p><b>Comments</b></p>	<p>Verbal train on core words not effective. All words appear to be echolalia, delayed echolalia, or pre-trained/ drilled phrases</p>	<p>Assumed she would use SGD to communicate across environments about tasks-at-hand. Instead she wants to talk about what she has been watching (movies).</p>	<p>Intelligibility improves although not a target obj of therapy</p>	<p>Intelligibility continues to improve although not a target obj of therapy. Still more easily understood at the single word and phrase levels. Inventive use of "hear" in place of "here"</p>	<p>Mother trained in several techniques for general language facilitation to decrease verbal prompts in an effort to increase child's spontaneous language production, expansion of communication, and variance of communication routines in natural environment. Increase length of phrases, semantic relations and variance in vocabulary noted.</p>
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\* Other therapies incl: OT/PT Hippoth Music Gymnastics Strict Diet

(PR) Parent Report

TTR - Type Token Ratio (measure of vocabulary variation within a person's speech)

**CODY**                      Age 3                      Male

Medical DX: Pervasive Developmental Disorder (PDD-NOS), Apraxia of Speech

Treatment DX: Profound Apraxia of Speech; Moderate Receptive Language Disorder, Severe Expressive Language Disorder

	<b>Baseline</b>	<b>6 Mos</b>	<b>12 Mos</b>	<b>18 Mos</b>	<b>24 Mos</b>	<b>30 Mos</b>
<b>Date</b>	8/1/08	1/6/2009	6/17/2009	12/21/2009	6/23/2010	1/3/2011
<b>Intervention</b>	Boardmaker, PECS w/ ALgS and sign lang. 3-hrs /week	LAMP, VTL direct select, Unity 84-1hit Full Core w/ mask; 3-hrs /week	VTL Unity 84 1-hit + LAMP* 3-hrs /week	VTL Unity 84 1-hit + LAMP* 3-hrs /week	VTL 84 Full + LAMP* 3-hrs /week	VTL 84 Full + LAMP* 3-hrs /week
<b>MLU</b>	<1.0	<1.0	1.00	1.30	Feb '10 MLU 1.56 & Mar '10 MLU 1.25 - poor testing subject	1.39
<b>Brown</b>	Early 1	Early 1	Early stage 1 w/out AAC - Late Stage 2 to Early Stage 3 w/ AAC	Stage 1	Stage 1	Stage 1
<b>Expressive (PLS-4) AE</b>	AE: 1.0	12 mos	18-22 mos	18-24 mos	AE: 18-24 mo	AE: 1.9 years
<b>Receptive(PLS-4) AE</b>	Age Equiv. 1.6	18 mos	18-24 mos	18 mos	18 mos	AE: 1.9 years
<b>Vocab (words)</b>	Parents rept 8, but stopped using them	10	27 verbal appx. + 27 AAC	50 (cued)	60 (cued)	70 (cued)
<b>Other Communication</b>	Has some gestures. Not id pix or body parts	Physical leading to desired item or activity	Increased attempts to imitate verbal words-5 signs	Verbal imitation, eye contact, physical leading.	Verbal imitation, eye contact, physical leading.	Emergent pointing gesture.
<b>Vocalization</b>	Crying.	Crying, occasional imitation of vowels.	30% intelligible at the word level with familiar partners	30% intelligible at the word level with familiar partners	30% intelligible at the word level with familiar partners; <10% intelligible when the context is unknown	30% intelligible at the word level with familiar partners; <10% intelligible when the context is unknown
<b>Attention</b>	5-15 seconds	~1 minute	Fluctuates between 2 minutes and 20 min	15-30 min	Fluctuates between 2 minutes and 20 min	Fluctuates between 2 minutes and 20 min
<b>Behavior</b>	gets frustrated - has meltdowns; unable to conduct direct assessment: uncooperative	Easily frustrated.	Decreased frustration.	More compliant during activities of high interest.	Sensory based activities resulted in better joint attention	has begun to fixate on activities and objects more so than in the pas
<b>Comments</b>	Apraxia of Speech diagnosed.		Has figured out how to get into toolkit to unmask cells; spontaneous verbalization, but # understanding?	begun to spontaneously verbalize in his home and therapy	Changes in Pt: diagnosed clinically with seizures. Already trained vocabulary was re-trained on 84 sequenced Unity program. Motor patterns for previously trained words had to be re-trained and re-learned.	Started Adderol medication to increase attention, gains in receptive skills, articulation and cognition. Also, increased readiness to learn skills achieved.

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\* Other  
therapies incl:  
(PR) Parent  
Report

3Xwk oral/apraxia  
w/ private SLP; 4 X  
30 min @schl;  
PT/OT/Rec  
Therapies;  
Hippotherapy,  
ABA Therapy,  
Dance, gymnastics,  
piano

**JOHN**

Age 3

Male

Medical DX: Pervasive Developmental Disorder, Chromosomal Abnormality, Apraxia,

Treatment DX: Profound Apraxia of Speech; Severe Receptive-Expressive Language Disorder

	Baseline	6 Mos	12 Mos	18 Mos	24 Mos
<b>Date</b>	6/19/09	12/31/2009	7/1/2010	1/4/2011	7/25/2011
<b>Intervention</b>		VTL 45 1-hit -> VTL 60 2-hit then to 84 Full + LAMP* 3-hrs /week	VTL 84 Full + LAMP* 3-hrs /week	VTL 84 Full + LAMP* 3-hrs /week	VTL 84 Full + LAMP* 3-hrs /week
<b>MLU</b>	<1.0 verbal	<1.0 verbal 1.14 AAC	<1.0 verbal 1.39 AAC	<1.0 verbal 1.31 AAC	1.5
<b>Brown</b>	Early Stage 1	Early Stage 1	Early Stage 1	Early Stage 1	Stage 1
<b>Expressive (PLS-4) AE</b>	9 mos (PR)	12-26 months	12-26 months	16-26 mos	16-26 mos
<b>Receptive (PLS-4) AE</b>	15 mos (PR)	18-24 months	24-36 months	3.3 yrs	3.7 years
<b>Vocab (words)</b>	0	17 (AAC)	50 (AAC/sign)	75 (AAC/Sign)	100 (AAC/Sign)
<b>Other Communication</b>	point, gestures, sign, screaming	some sign, pulling, runs to obj.	using sign head nod Y/N	sign frequently inventive gestures	Sign. Novel gestures
<b>Vocalization</b>	0	spontaneously imitates vowels + 4 other sounds; Child verbally approximated "go, home, up" once each during session.	spontaneous babbling no words	spontaneous onotomopia no words	Vocalizing approximations of some words: go, mom, hey
<b>Attention</b>	<1 min span	eye gaze better Joint attn = 15 min	good eye contact Longer atten. w/ moderate cues	Attention generally maintained w/ moderate cues	Eye contact and attention maintained during activities of high interest, especially when child is controlling activity and if there is more than one adult working with the child at the same time.
<b>Behavior</b>	Very aggressive. Frustrates easily, throws items, hits others, self-injurious	Tolerates therapy for longer sessions	Behaviors have improved dramatically; compliance issues remain	Still requires frequent beh mod for compliance and has difficulty transitioning easily between tasks	Frequent behavior modification techniques utilized to maintain instructional control during the therapy sessions.
<b>Comments</b>	Avoids increased expectations	Attention increased-able to administer reception subtest of PLS-4 for first time. Needed moderate cues to communicate with others.	Therapy also focusing on apraxia drills and dysphagia intervention. Addtl med diagnoses of Carnitine Deficiency Syndrome and Epilepsy	seizures neg. affect S.T. memory	Continued seizure activity; missed therapy frequently for doctor visits, holidays, and training/receipt of service dog.

\* Other therapies incl:  
OT/PT, School ST 1XWK, Hippotherapy, Music  
Th, Gymnastics, Strict Diet

(PR) Parent Report

ZOE

Age 6

Female

Medical DX: Autism

Treatment DX: Apraxia of Speech, Severe Receptive-Profound Expressive Language Disorder

TA	Baseline	6 Mos	12 Mos	18 Mos
<b>Date</b>	10/1/09	5/1/2010	12/1/2010	8/11/2011
<b>Intervention</b>	Manual Communication Board	VTL 84 Full + LAMP* 2 X Wk	VTL 84 Full + LAMP* 1 X Wk	VTL 84 Full + LAMP* 1 X Wk
<b>MLU</b>	~1	1.0	1.68	
<b>Brown</b>	Early Stage 1	Brown's Stage 1	Brown's Stage 1	Brown's Stage 1
<b>Expressive (PLS-4) AE</b>	2.2 Yr (Parent Report)	12 mos	12-18 mo 18-24 mo(AAC)	18-31 mo TTR: 64% (56/87 words) (AAC)
<b>Receptive (PLS-4) AE</b>	3.9 yr (Parent Report)	12-18 mos	18-24 mo	2.1 years
<b>Vocab (words)</b>	~50	40-50 (Verbal and AAC)	121 (Verbal & AAC)	171 (Verbal & AAC)
<b>Other Communication</b>	gestures, vocalizations (when prompted), verbalizations (both intelligible and unintelligible), and physical leading to an intended item or task.	Verbalizing 1-word one to two times in an hour-long period.	Mostly cued/prompted communication.	Shows advances in the use of present progressive verb forms and plural nouns.
<b>Vocalization</b>	able to understand approximately 50% of her verbal productions within context and only 10% out of context	Limited speech output is 20% intelligible to familiar listeners.	spontaneously begun to verbally imitate the productions made by the SGD	Spontaneous verbal imitation of what is said by SGD continues
<b>Attention</b>	Req 5 min calming	Cooperative but difficult to engage in activities with manual board	8 min joint attn	Up to 10 minutes during highly motivating activities.
<b>Behavior</b>	Her attention & engagement dependent on motivation, rewards from the clinician.	More compliant more verbal at home	Decrease in stim. behavior	Infrequent meltdowns, able to show shared focus with less intervention.
<b>Comments</b>	She does not combine words & has limited use of verbs, adjectives, pronouns, articles in her verbal repertoire	Tried manual Board & have to cue everything. Would not use manual forms of AAC to initiate. When trial VTL - in 2 wks spontaneous. 7 weeks using possessive. Change in behavior: more compliant	Still cuing/ prompting much of her communication	Developm.Assessment of Young Children (DAYC) Communication<59 25 mos Social-Emotional <70 35 mos Cognition<72 40 mos Adaptive Behavior<90 52 mos

\* Other therapies incl:

Sensory Aspect: Gymnastics/ Baseball,  
slp/2xwk schl

**TRENT**

Age 6

Male

Medical DX: Autism

Treatment DX: Profound Mixed Receptive-Expressive Language Disorder

	<b>Baseline</b>	<b>6 Mos</b>	<b>14 Mos</b>	<b>24 Mos</b>
<b>Date</b>	7/29/09	2/22/2010	10/15/2010	7/26/2011
<b>Intervention</b>	32 Location Static Comm. Device + 32 Loc. Manual Language Board 2-hrs /week	32 Location Static Comm. Device + 32 Loc. Manual Language Board 2-hrs /week	Since 8/10: VTL 84 Sequenced w/ Keyguard + LAMP* 7 core words & 10 fringe Limited words accessible 3-hrs /week	VTL 84 Sequenced w/ Keyguard + LAMP* 52 core words & 67 fringe words 3-hrs /week
<b>MLU</b>	<1.0 verbal	<1.0 verbal	1.0	1.20
<b>Brown</b>	Early Stage 1	Early Stage 1	Stage 1	Stage 1
<b>Expressive (PLS-4) AE</b>	6 mos	9-12 mos.	12-18 mos	18-24 mos
<b>Receptive (PLS-4) AE</b>	12 mos	18-24 mos	18-24 mos	18-24 mos
<b>Vocab (words)</b>	0 (verbal)	3 (verbal)	17 (AAC) w/ cues	102 (AAC) w/ cues
<b>Other Communication</b>	hitting, biting, self-abusive actions, kicking	will smile during sessions, minim. facial expressions	Physically leading to desired item/activity.	Smiling, sustained eye contact.
<b>Vocalization</b>	4 words: repetitive, inconsistent, echolalic	4 words: repetitive, inconsistent, echolalic	verbalizations, now including "momma, no, eat", have increased	Verbalizations: "no, eat, mama, more." Increased frequency of production.
<b>Attention</b>	Does not have the attention skills to tolerate an accurate stndzd assmt. Formal eval was attempted, yet aborted after client could not attend to the test stimuli	eye contact is fair but variable	went from total hnd/hnd to 42/45 spont in 1st day w/ VTL	Slow progress... Behavior & health issues. However, these outbursts have improved since arrival of AAC device
<b>Behavior</b>	Biting, shaking his hands, shaking a DVD case, staring intently at an object, stroking the carpet, running from one side of the room to the other	More cooperative. Mod-max redirection. Will take adult finger in hand to press device (80%) Spont Indep (10%) Hand/hand (10%)	Combative during therapy. Behavior mod heavily required still resists activities at times	Frustration has significantly decreased shown greater independence
<b>Comments</b>	Diffic. To motivate, negative self-injurious behaviors	Paired recorded speech w/ manual board brings incr. attn & spontaneous initiation	making basic requests related to activities he enjoys (esp. eat/drink)	Progr. affected by how therapy techniques are carried over to other environments. Needs tactile support to his hand (ie. Him holding the adult's hand for added tactile input or as a prompt only -no direction given)

\* Other therapies incl:

Music Therapy, ABA, Private special school,

(PR) Parent Report

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