

Language Acquisition Through Motor Planning (LAMP): Impact on Language & Communication Development for Students with Complex Disabilities

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BOSTON COLLEGE

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Curriculum and Instruction

LANGUAGE ACQUISITION THROUGH MOTOR PLANNING (LAMP): IMPACT
ON LANGUAGE & COMMUNICATION DEVELOPMENT FOR STUDENTS WITH
COMPLEX DISABILITIES

Dissertation
by

PATRICIA H. MASON

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of the requirements of the degree of
Doctor of Philosophy

ABSTRACT

Language Acquisition Through Motor Planning (LAMP): Impact on Language & Communication Development for Students with Complex Disabilities

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Augmentative and alternative communication (AAC) is central to the lives of many individuals who are not able to effectively use spoken language. AAC systems are an essential component of a student's ability to access his/her world, including daily communication and school content. The provision of such systems is a high priority in the field and supports the emancipation of those with limited voice, power, and independence that must function within a social structure that has been designed for the more typically abled. The study employed a single-case multiple staggered baseline design with randomized intervention implementation and intervention schedule using the What Works Clearinghouse (WWC) standards from 2010. Five students with complex disabilities using advanced speech generating devices with the LAMP method, Language Acquisition Through Motor Planning, (Halloran & Halloran, 2006), of picture symbol organization participated in the study. The LAMP method was examined, and the potential impact on language and communication it may have. Specifically, the ability to use print versus picture symbols for communication and literacy was investigated within the context of a highly structured 1:1 literacy lesson facilitated by interventionists.

Results indicated that all students made varying degrees of gains in the use of print words. These gains were sustained in the generalization phase. Operational skills

were impacted demonstrated by increased skill development in navigation of the speech generating device and the type of vocabulary selected. In addition, communication functions were expanded, and in some cases, there was a significant increase in the complexity of word usage across people and settings. Discussions on interventionists perceptions are presented and integrated within individual student results providing context and direction on training needs.

DEDICATION

To all present and future users of augmentative and alternative communication.
To all those who were and continue to be so patient, as the research continues to find
ways to open the world to all.

J.R. (Junior)

We traveled a long road together. The endearing support and comfort you provided so many adults and children will never be forgotten. You helped so many children use their voices, learn to walk and relax when they were in discomfort. You were loved by all of us and will live in our hearts forever. Your compassion and empathy cannot be duplicated. We will miss your wonderful yelps and howls as you engaged with all. You were the most amazing service dog and friend. Thank-you for all that you have given me. You will always bring a smile to our faces as we remember our wonderful times here on earth.

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TABLE OF CONTENTS

Dedication.....	i
Acknowledgements.....	ii
Table of Contents.....	iii
List of Tables.....	ix
List of Figures.....	xi
CHAPTER ONE: INTRODUCTION.....	1
Research Problem.....	1
Glossary of Important Terms.....	7
Research Questions.....	11
CHAPTER TWO: REVIEW OF THE LITERATURE.....	13
Communicators with Complex Disabilities.....	13
Brown’s Stages of Development.....	15
Augmentative and Alternative Communication.....	17
Symbol Displays & Vocabulary.....	17
Core Vocabulary and Transparency.....	20
Vocabulary (Symbol) Animation.....	22
Display Organization.....	23
Language Acquisition Through Motor Planning (LAMP).....	26
LAMP: Readiness to Learn.....	29
LAMP: Shared Engagement.....	29
LAMP: Auditory Signals.....	30
LAMP: Natural Consequences.....	32

LAMP: Consistent Motor Patterns.....	32
Teacher Interactions.....	34
Identification of Communicative Acts.....	34
Communication Dyad.....	36
Facilitation of Interactions.....	38
Teacher Perspectives, Attitudes, and Beliefs.....	42
Positive Assumptions.....	43
Barriers.....	45
Identified Needs.....	48
Collaborative Teams.....	49
Teams Sharing Knowledge.....	50
Teams Engagement with AAC.....	50
Education and Training.....	54
Teacher and Paraeducator Training.....	55
Training and Implementation of Specific AAC Approaches.....	56
Professional Development and Education Programs.....	58
CHAPTER THREE: METHODS.....	61
Mixed Methods Research.....	61
Setting.....	64
Inclusion/Exclusion Criteria.....	65
Research Participants.....	67
Ethics Approval.....	72
Data Collection Procedures.....	73

Procedural Fidelity.....	78
Analytic Plan.....	79
Limitations.....	82
CHAPTER FOUR: RESULTS AND DISCUSSION.....	84
Summary of Interventionist Perceptions.....	85
Impact on Communication including Social Validity.....	87
Impact on Language.....	88
LAMP.....	89
Training & Collaboration.....	91
Brenden.....	95
Impact on Language.....	96
Impact on Communication.....	104
Generalization.....	105
Inter-Rater Reliability.....	111
Sam.....	112
Impact on Language.....	113
Impact on Communication.....	120
Generalization.....	121
Inter-Rater Reliability.....	124
Holly.....	125
Impact on Language.....	126
Impact on Communication.....	133
Generalization.....	135

Inter-Rater Reliability.....	138
Cameron.....	138
Impact on Language.....	139
Impact on Communication.....	147
Generalization.....	148
Inter-Rater Reliability.....	151
Ruth.....	151
Impact on Language.....	152
Impact on Communication	158
Generalization.....	159
Inter-Rater Reliability.....	161
Summary of Student Participant Outcomes and Interventionist's Perceptions.....	162
Summary Impact on Language.....	163
Summary Impact on Communication.....	165
Summary of Interventionist's Perceptions.....	167
CHAPTER FIVE: CONCLUSION AND IMPLICATIONS.....	169
Implications for Language Development.....	171
Implications for Communication Development	173
Role of Trained Communication Partners.....	175
Implications for Future Research.....	177
Limitations.....	180
Conclusion.....	181

REFERENCES.....	182
APPENDIX A: Transcript of Utterances and Brown's Stages per Student.....	214
Brenden.....	214
Sam.....	226
Holly.....	236
Cameron.....	249
Ruth.....	266
APPENDIX B: Summary of Communication Intent/Function per Student.....	274
Brenden.....	274
Sam.....	276
Holly.....	278
Cameron.....	280
Ruth.....	282
APPENDIX C: Transcript of Generalization Phases per Student.....	284
Brenden.....	284
Sam.....	286
Holly.....	287
Cameron.....	288
Ruth.....	290
APPENDIX D: Interview Questions.....	292
APPENDIX E: Interventionist Data Recording Sheet.....	294

LIST OF TABLES

Table 1.....	63
Table 2.....	67
Table 3.....	72
Table 4.....	81
Table 5.....	95
Table 6.....	97
Table A7.....	214
Table B8.....	274
Table C9.....	284
Table 10.....	112
Table 11.....	114
Table A12.....	226
Table B13.....	276
Table C14.....	286
Table 15.....	125
Table 16.....	127
Table A17.....	236
Table B18.....	278
Table C19.....	287
Table 20.....	139
Table 21.....	141
Table A22.....	249

Table B23.....	280
Table C24.....	288
Table 25.....	151
Table 26.....	153
Table A27.....	266
Table B28.....	282
Table C29.....	290

LIST OF FIGURES

Figure 1.....	98
Figure 2.....	100
Figure 3.....	103
Figure 4.....	106
Figure 5.....	107
Figure 6.....	116
Figure 7.....	117
Figure 8.....	120
Figure 9.....	122
Figure 10.....	123
Figure 11.....	129
Figure 12.....	131
Figure 13.....	133
Figure 14.....	136
Figure 15.....	137
Figure 16.....	143
Figure 17.....	144
Figure 18.....	146
Figure 19.....	149
Figure 20.....	150
Figure 21.....	154
Figure 22.....	155

Figure 23.....	158
Figure 24.....	160
Figure 25.....	161

CHAPTER 1

INTRODUCTION

Research Problem

The topic of augmentative and alternative communication for students with complex disabilities has become a prevalent theme over the past 15 years, moving to the forefront of the current discourse on public policy and professional practice.

Augmentative and alternative communication (AAC) is central to the lives of many individuals who are not able to effectively use spoken language. AAC systems are an essential component of a student's ability to access his/her world, including daily communication and school content. The provision of such systems is a high priority in the field and supports the emancipation of those with limited voice, power, and independence that must function within a social structure that has been designed for the more typically abled.

Prioritization of research-based methodologies which address the effective use of AAC can be seen through the varied studies on an array of the more established approaches. These studies have explored in more depth, the extensive human and non-human variables which may impact the effectiveness of AAC as well as the need for individualization and context specific considerations. The absence of replicated research investigating the effectiveness of new methodological approaches in the area of AAC is problematic. The effective and ongoing ability to communicate and engage in the world must be made a high priority in the research field. It is research for praxis. That is, we must act and reflect on our practices, moving the field forward and expanding upon

access and full participation. AAC embodies many aspects associated with the ideals of social justice.

Williams, Krezman & McNaughton (2008) discuss five principles which must be considered;

- The time for AAC is now;
- One is never enough;
- My AAC must fit my life;
- AAC must support full participation in all aspects of 21st century life;
- Nothing about me without me (p.194).

Participation as a full member of society requires the ability to have and use voice as a form of expression and power. When we limit, confine and reduced language and communication to simplified interactions, we perpetuate these misconceptions of the abilities, cognitive powers and internal desires of the people we are charged to serve. The investigation of new methodological approaches provide the promise of informing our practice and adding to the body of knowledge, allowing us to pose new questions, and ultimately add to our ability to monitor and examine the field of augmentative and alternative communication.

AAC systems provide alternative forms of communication for people who are not able to access spoken language. AAC systems may be unaided where the person may use sign language, facial expressions and/or gestures to communicate. Aided AAC systems include a variety of supports such as; pictures, objects, tangible symbols, communication boards and electronic devices. These supports are highly individualized to facilitate both

language and communication development (Beukelman & Mirenda, 2013; Downing, Hanreddy & Peckham-Hardin, 2015; Johnston, Reichle, Feeley & Jones, 2012; Robinson & Soto, 2013). The study looks specifically at advanced electronic communication systems. Advanced systems can include 30,000 words or more, with interconnecting page communication pages to facilitate more advanced communication, literacy and full participation.

The introduction of more advanced electronic AAC systems has brought with it the potential for better long term outcomes along with some anticipated and unanticipated challenges. The first area of consideration is symbol access which involves some type of direct selection (Myrden, Schudlo, Weyand, Zeyl & Chau, 2014; Wilkinson & Hennig, 2007). Both Myrden et al. 2014 and Wilkinson & Hennig (2007) point out the rapidly changing technology which has facilitated greater access to and engagement with more advanced communication technologies. These more advanced systems allow for robust vocabulary development and increased engagement across all aspects of life. As a result, access methods have become a centralized piece along with symbol displays. AAC users may access technology through various forms of direct selection which include; pointing/touching, eye-gaze, laser pointing and auditory scanning. Myrden et al. 2014 go on to discuss the issues of device abandonment over time from lack of use. They supposed that this can be due to lack of training of both the AAC user and other communication partners as well as a poor match of the device with the user. Those who consistently used the device(s) over time were more likely to stick with it. In addition, the variety of access methods has changed the landscape of possibilities for device engagement. This includes a trend towards using more universally designed typical

electronic devices such as tablets which include the same variety of access methods as the larger advanced communication devices (p.115). Universally designed devices offer an inclusive approach to communication and digital language systems. Research has yet to focus on possible differences in outcomes including differences in perception and interactions of those who use more typical AAC supports such as tablets versus those who engage with specially designed hardware. With the increase in access methods compatible with tablet based technologies, it is reasonable to anticipate that this increased trend will continue in the future.

Symbol displays are a second area which must be considered. With the influx of more advanced technological systems, fixed displays are many times being replaced with dynamic software or application based systems which expand upon vocabulary, user control and personalization. Wilkinson and Hennig (2007) point out that, “Dynamic displays can be used in similar ways to fixed displays, except now the user has potentially more independence in navigating and even programming the device” (p.61). The potential increase in efficiency of such dynamic displays causes pause for practitioners and AAC users who must now also consider how to evaluate the effectiveness of these tools given trends in device abandonment and overall training needs. Ratcliff, Sutton and Lehman (2009) conducted a preliminary study looking at developing metrics to evaluate these speech generating devices and their associated software programs (p.178). Specifically, they looked at three different devices and the ability of the user to produce more complex comments and sentences including their rate enhancement features. These advanced devices support the facilitation of increasingly complex and sophisticated language and communication is an essential component to current and future practice.

Ratcliff et al. (2009) found that several features of each software program can be used to evaluate the overall efficiency and challenges. In particular, “keystrokes, time, keystrokes per minute, and accuracy have the potential to provide objective information...” (p.185). These preliminary metrics can guide research in the effectiveness of new technologies, display designs, software systems and methodologies to inform the field and research practices.

Research based methods which support complex language development while facilitating communication across partners and environments are critical to the long-term outcomes of people with more complex disabilities. The current study seeks to explore an emerging method in the area of AAC; Language Acquisition Through Motor Planning – LAMP (Potts and Satterfield, 2012). It will make use of the preliminary metrics researched by Ratcliff, Sutton & Lehman (2009). The LAMP method is grounded on component based research with limited peer reviewed studies. It is important to note that based on the current LAMP research, it does address the six tenets for supporting communication established by the National Joint Committee on the Communicative needs of Persons with Severe Disabilities (NJC, 1992) that are applied to frame the current study in best practice.

NJC Six Tenets:

- Communication is social behavior.
- Effective communicative acts can be produced in a variety of modes.
- Appropriate communicative functions are those that are useful in enabling individuals with disabilities to participate productively in interactions with other people;

- Effective intervention must also include efforts to modify the physical and social elements of environments in ways that ensure that these environments will invite, accept, and respond to the communication acts of persons with severe disabilities;
- Effective intervention must fully utilize the naturally occurring interactive contexts (e.g., educational, living, leisure, and work) that are experienced by persons with severe disabilities.
- Service delivery must involve family members or guardians and professional and paraprofessional personnel.

(<http://www.asha.org/policy/GL1992-00201/>)

This study integrates two theoretical frameworks to guide the research through a more deductive approach. Green (2014) points out that frameworks can provide an organizational structure when making direct connections to a current body of research. A semantic-cognitive and behavioral lens will be used as the theoretical framework to understand and explore methodological stances on AAC and to examine through applied research the LAMP intervention.

The semantic-cognitive theory of language, “proposes that young children pay particular attention to the meanings of things....In other words, the experience comes first, and then the language follows” (Kuder, 2013, p.50). This supports the use of language in the context of routines. Routines are predictable, build anticipation, and reinforce both the contextualized language as well as more generalized meanings. Behavioral theorists view language as an externally learned behavior. Children imitate what they see, experience and hear. These skills are either reinforced by the external

world or more likely to be repeated and expanded upon, or are diminished by the lack of feedback (Beukelman & Mirenda, 2013; Johnston, Reichle, Feeley & Jones, 2012). This can play a strong role in supporting communicative behaviors which is a part of the fourth and fifth tenet set forth by the NJC.

The use of AAC can be viewed in behavioral terms as well as in a semantic-cognitive framework where symbol supports are used to interpret, receive and express information in the context of routines with communication partners in which behavior is shaped to support more efficient engagement, understanding and the joint recontextualization of interactions which expand upon basic understandings to more advanced application of language. This joint application and framework supports all six tenets of the NJC.

Glossary of Important Terms

Communication:	Communication is the sharing of information across a variety of modalities.
Communication Function:	Gail Van Tatenhove (2007) discusses communication function as relational functions. That is, communication functions are those acts which have a pragmatic component such as but not limited to; directives, requests, associatives, naming and greeting (p. 4). The variety and complexity of communication functions can range from a single word to complex sentences.

Communication Partner: The communication partner is someone who is actively engaging in a conversation or interaction with an AAC user. This can be of a social, educational or professional/formal nature. In addition, Kent-Walsh & McNaughton (2005) point out that, “communication partners must be able to send and receive messages (i.e. interact) successfully with individuals who use AAC in order to experience effective communication interactions” (p. 195).

It is also important to note that communication partners also play a role in modeling or stimulating language. Communication partner modeling occurs when the partner interacts with the AAC user’s system by activating one or more of the symbols to communicate a specific message. Beck, Stoner & Dennis (2009) in their discussion on aided language stimulation point out the importance of modeling messages to assist in facilitating responses from the AAC user (p.43). Partner modeling also supports the development of literacy.

Literacy: Literacy is generally understood to be the ability to read and write at a level which allows the person to read to learn as well as to effectively convey information through written or other accessible forms.

Hetzroni (2004) points out that, Literacy is a tool for achieving cultural and social power, and for people with disabilities it might be the primary channel to language, knowledge, and communication” (p. 1305). For AAC users, the interaction with symbols is a key component of literacy.

Symbol: A symbol is a letter, number, word(s), or graphic image representing a specific or generalized concept. Symbols are represented on a student’s device by using a graphic with a letter, number or word(s) or by using just the letter, number or printed word(s). A symbol is considered to be part of the potential vocabulary of the AAC user.

Vocabulary: Vocabulary is commonly taken to mean a set of words or phrases. Symbol (word, letter, number or graphic) selection will be defined as a direct response by the student to indicate or activate a specific selection on their AAC device.

Selection: Selection may take the form of; using a finger(s) to press and activate a symbol; using a stylus to press and activate a symbol or by using a directed eye-gaze which is sustained for a predetermined time based on individual student criteria. Symbol selection may require communication partner support at times. This support will be referred to as a prompt.

Prompt: Dynavox (2011) provides a simple prompting structure which will be employed by this study. A least to most approach will be used allowing the AAC user multiple opportunities to respond with the least restrictive supports applied first. Prompting levels include;

- | | |
|---------------------------|--|
| Natural Cue (NC): | AAC user or communication partner initiates a response independently. |
| Indirect Cue (IC): | Verbal comment repeating or rephrasing initial response, gesture, using a light/laser to point at communication device but not at any specific symbol. |
| Direct Verbal Cue (DVC): | Verbally direct a response by restating the initial response and indicating the appropriate response in return. |
| Direct pointer Cue (DPC): | Directly showing the location of the initial or next symbol to be selected. |
| Physical Assistance (PA): | Physically assist the AAC user in activating the message on their device. |

(<http://ie.dynavoxtech.com/implementation-toolkit/>)

These measures as indicated by Ratcliff et al. (2009) will assist in providing information on the effectiveness of the features being addressed in this study.

Transdisciplinary Approach: Members of a student's team work collaboratively to design and implement services. Each member of the team carries over this collaboratively designed set of services so that the student receives consistent support and opportunity to participate in skill development (Downing & Bailey, 1990).

Social Validity: Social validity can be defined as that which has value to an individual and/or society as a whole.

Research Questions

Using the integrated theoretical frameworks of a semantic-cognitive and behavioral lens and the six tenets of best practice outlined by the NJC, the following research questions will be explored;

1. How does the LAMP method impact language acquisition?
 - a. What changes occurred in types vocabulary acquisition?
 - b. What impact did print vocabulary have on usage of those individual words or phrases?
 - c. What impact was there on student utterances?
2. How does the LAMP method impact communication development?
 - a. How has the LAMP method impacted communication functions initiated and responded to by each student?

- b. What impact has the LAMP method had on the efficiency of communication as it relates to elicited and student initiated responses?
- 3. What are interventionist's perceptions regarding the use of LAMP with their individual students?
 - a. What are interventionist's perceptions regarding training and practice using the LAMP method with their individual student?

These questions and sub questions address the unique challenges supporting more efficient vocabulary acquisition, conservation of effort in using AAC systems as well as supporting increasingly complex interactions.

CHAPTER 2

LITERATURE REVIEW

Communicators with Complex Disabilities

Students with complex disabilities who have limited to no spoken language present the field of AAC with a number of challenges, especially in terms of determining intentional communicative acts (ICAs). Equally challenging are the assumptions which equate severe disabilities with severe intellectual impairment. Students with more complex disabilities require extensive individualized supports to access, organize and make sense of the world in which they must function. This world, as mentioned earlier, was designed for those more typically abled, with spoken language the dominant means of face to face interactions. For the purposes of this study, it is important to discuss how communication skills may impact outcomes, as well as establishing a set of terms for which various levels of communicative engagement can be described.

To begin, the use of AAC to support communication and language development does not require a set of prerequisite skills from which to benefit. Ronski and Sevcik (2005) discuss several myths which have impacted consistent AAC implementation. The historic desire to enforce specific prerequisite skills for the effective use and implementation of AAC holds individuals with the most complex disabilities to a standard not imposed upon speaking children and adults. Ronski and Sevcik (2005) state that, “Some individuals with severe sensori-motor disabilities cannot demonstrate their cognitive abilities without a means by which to communicate so we cannot insist on evidence of those abilities before providing AAC services and supports” (p.180). With the removal of such prerequisites, it remains important to understand the potential

developmental sequence various communicators may be at to better respond and develop their ICAs.

Ogletree, Bruce, Finch, Fahey and McLean (2011), discuss three primary categories of communicators which will be helpful when considering the use of AAC. Perlocutionary communicators engage with people given extensive facilitator support. Understanding, interpretations and engagement is generally initiated and supported by the facilitator in the context of familiar routines (Ogletree & Pierce, 2010). Communication may be more passive at this stage with limited occasions where students may initiate reaching towards an object/person or pushing it away. Facial expressions, emotion and simple movements are often used and interpreted by the communication partner (Ogletree et al. 2011). Behavioral and semantic-cognitive theory recognizes the emergences of ICAs as they are often shaped, reinforced and interpreted in context. Language emerges as a function of consistent feedback within consistent meaningful daily routines.

Illocutionary communicators have some established gestures and may use some symbols in a meaningful way but have a very limited or narrow understanding of the language they may represent. According to Johnston, Reichle, Feeley and Jones (2012), students within this communication phase can range from deictic to representational. Receptive representational understanding tends to be context driven and not necessarily applied to novel scenarios. Communication interactions may be extended slightly with more explicit attention to the partner through gestures, eye-contact or reference to a shared object. Here we would see more ICAs expressed within the contexts of routines including more active participation. Communication is becoming more social with simple

communicative functions (protest, acceptance, emerging joint attention) all within the context of naturally occurring routines.

Finally, locutionary communicators are able to engage with symbols through a variety of modes. This can include spoken language, picture symbols, written words, formalized gestures/signs and may use advanced speech generating devices (SGAs). Multiple modalities are used simultaneously in increasingly complex and novel ways (Ogletree et al., 2011). The number of novel communication partners begins to expand and the generalization of skills beyond the scope of familiar routines and activities emerges. Intentional communicative acts are much more flexible in how they are maintained and expanded upon for greater periods of time.

In the next section Brown's stages of development (Owens, 2016) are discussed in relationship to supporting AAC users, and the development of more complex communication including monitoring the increase in mean length of utterance. Documenting the formation of utterances and their grammatical structures assist the field of AAC in understanding how to provide more effective interventions and supports. The expansion of MLU can support greater clarity in message and access which in turn facilitates full participation.

Brown's Stages of Development

Typical language development provides a source of comparison for students who use AAC devices and communication software. Brown's stages of development (Owens, 2016), are often used as a framework to look at the early stages of language development. Specifically, mean length of utterance (MLU) is measured through the stages developed by Brown (Baurly & Gottwald, 2009; Rice, Redmond & Hoffman, 2006; Shipley &

McAfee, 2016; Yoder, Molfese & Gardner, 2011). AAC users present with varied levels of complexities in terms of their language and ability to expand upon their communication (Johnston, Reichle, Feeley & Jones, 2012; Ogletree, 2011). MLU is a critical component in language and communication expansion. The operational differences in producing utterances and reading picture symbol sequences may impact how students construct their utterances.

Trudeau, Sutton, Morford, Côté-Giroux, Pauzé and Vallée (2010) looked at how AAC users form and read graphic-symbol sequences. They reason there may be differences in the length and structure of the utterances produced. The study found very consistent and stable response patterns across participants. The key factor in producing these frequent utterances was the consistent use of specific strategies to support communication and utterance expansion both receptively and expressively. Applying Brown's stages to utterances, provides a method of progress monitoring in the area of MLU to specifically address skill acquisition, as well as assist in identifying appropriate interventions and possible barriers. Yoder and Davies (1990), looked at how adults with developmental disabilities used specific utterances to respond in conversations based on Brown's stages. Utterance length was highly influenced by the adult topic chosen and the supports and prompting provided. Secondly, utterances that were two or more words tended to focus on child directed topics with prompting support. Child directed interactions which support choice, demonstrate mutual respect of the child's wishes and what topics are most meaningful to them.

The use of Brown's framework may also help us understand the effectiveness of specific symbol communication displays in relationship to how AAC users are able to

form increasingly complex utterances and advance their communication functions across people and environments. Using this structure to assess utterances may provide the common point of comparison to bridge what we know about individual AAC systems and their software, and how we make decisions in their vocabulary access.

Augmentative and Alternative Communication Symbol Displays & Vocabulary

Symbol Displays and Vocabulary

Symbol communication displays make-up a key component of AAC systems and have been the subject of multiple studies addressing various characteristics which may lead to greater student success. Several important themes emerge from this research including; vocabulary selection, symbol transparency and minimizing demands both in the learning of the display and the overall interaction with the display. Studies reviewed included a variety of research methodologies with both typically developing young children and adults as well as children with disabilities. Research using typically developing children and typical adults can provide insights into communication and language development which can directly benefit and be applied to children with disabilities. More directly, “Using typically developing children allowed for determining the effects of AAC organizations on learning without the confounding variables of motor, sensoriperceptual, or other impairments” (Drager, Light, Carlson, D’Silva, Larsson, Pitkin and Stopper, 2004, p.1135). This is contrasted with the studies focusing on explicit individualized AAC supports for children with disabilities and their responses to various displays and icons. These studies tend to look at very specific selection methods and student driven vocabulary development which is contextually driven (Branson &

Demachak, 2009; Ganz, Earles-Vollrath, Heath, Parker, Rispoli & Duran, 2012; Thunberg, 2011).

Students with multiple disabilities and complex communication needs have benefited tremendously from the advancement in communication technology. Currently there are a multitude of companies and device options available for students and adults. As a result of the greater availability of these devices, students have increased access to both simple and advanced vocabulary systems which grow with the student and provide ongoing exposure to symbols both familiar and unfamiliar thus mirroring more typical language acquisition. How this vocabulary is selected and organized is essential in minimizing the demands of the system on the student as well as addressing memory supports and overall retrieval abilities.

Choice in devices is another piece which must be included when determining the best options for students and potential long term benefits and outcomes. AAC users should be actively involved in the determination of the most compatible device. Canella-Malone, DeBar & Sigafoos (2009) studied student device preference using a multiple probe across device design with two students who presented with significant intellectual disabilities. Although this was a limited study given only two case examples, it did highlight a couple of key considerations and findings. One student clearly was able to indicate preference between the three devices offered indicating that given the right support and accurate preference assessments, it is possible for students with intellectual disabilities to participate in their personal device selection (p.270). The second student showed inconsistencies in selection and struggled with identifying the correct icons. These types of inconsistencies can be unique to each student. Canella-Mallone et al.

(2009) supposed that this could be due to the prompting procedures (least to most). Prompting was reversed (most to least) with greater progress in correct icon selection (p.271). Prompting procedures would be considered a part of the device training including the support of vocabulary acquisition and organization. It can be inferred that prompting procedures prior to device implementation or selection must be assessed to support the best possible individual outcomes.

Memory demands and cognitive capacity play a strong role in vocabulary selection and overall engagement with the dynamic displays. An AAC user must be able to direct attention to the dynamic display while filtering out other extraneous stimuli which may impact overall processing abilities. Thistle and Wilkinson (2013) define working memory, “as the various cognitive means by which individuals maintain and manipulate information while completing a task” (p.236). Tan, Zhao, Tian, Cui, Yang, Pan, Zhao and Chen (2015) point out the consistent influx of sensory information which forces each person to selectively attend to that which is deemed the highest priority. When we consider the demands of a dynamic display, it is critical to consider this constant bombardment of outside stimuli which is competing with the processing needed to organize, select and ultimately convey a specific message. This selective attention is a skill which is required for ongoing engagement with an AAC system. AAC selection methods and displays may place higher demands on students. Wagner and Jackson (2006) and Thistle and Wilkinson (2013) point out several factors which influence the efficiency and effectiveness of AAC displays and selection methods. Each selection method and display requires the individual to remember the initial symbol selected while considering the selection of additional vocabulary to convey a message. This uses

additional amounts of memory and cognitive processes to coordinate the construction of a response. To place this in better perspective, consider thinking of a communicative message and then locating the concrete symbols in the correct order associated with this message. There are innate inefficiencies and additional memory and cognitive demands placed on this form of communication. The anticipation associated with the communication partner's response requires continued selective attention and anticipation of reciprocal message conveyance. Considering the complexities of working memory, attending and the demands on cognitive processes, vocabulary transparency must be considered.

Core Vocabulary and Transparency

Historically vocabulary selection has focused on what has been termed the functional aspects of communication. Vocabulary selection often began by focusing on basic needs and request making within familiar routines and environments. The development of these basic communicative functions provides the foundation for increased vocabulary and interaction within the environment (Iacono, Trembath & Ericson, 2016; Na, Wilkinson, Karney, Blackstone & Sifter, 2016). Vocabulary selection is often based on student preference with highly motivating symbols used to motivate initial communication. Mineo, Peischl and Pennington (2008) discuss common assumptions associated with icon transparency. Items which are much more concrete and specific such as a picture of a yellow banana are considered much more transparent than an icon representing where. Symbol transparency is impacted by experiences, linguistic abilities, concrete versus conceptual representations and the overall complexity of the representation. The lack of varied representations which do not consider all the factors

mentioned can lead to problems in developing a robust vocabulary which supports greater communicative fluency and increasingly complex language patterns. In general, the introduction of very specific noun based vocabulary lends itself to smaller vocabularies for many students with significant disabilities (Snodgrass, Stoner & Angell, 2013, p.322). To address this concern, the introduction of what has been termed core vocabulary has emerged. According to Beukelman and Mirenda (2013), “Core vocabulary refers to words and messages that are commonly used by a variety of individuals and occur very frequently” (p.31). These are generally high frequency words which are based on student age, developmental level and the contexts in which the student functions on a daily basis. These words tend to be much less concrete and more conceptually oriented with concerns of symbol transparency. Lack of symbol transparency may lead to greater learning demands on cognitive, motor and working memory. This must be balanced with long term goals focusing on increased generalized use of vocabulary which will meet much broader communicative needs across environments, routines and communication partners (Thistle & Wilkinson, 2015, p.130).

Research on core vocabulary is emerging. Snodgrass, Stoner and Angell (2013) using a single-subject multiple baseline variation study, provided evidence that students with multiple disabilities could learn conceptually referenced vocabulary as well as generalizing this vocabulary to unfamiliar events and context. They pose that “...our use of conceptually referenced symbols is particularly important because these preliminary findings may have implications for initial AAC vocabulary selection...” (p.331). In addition, the American Speech Language Hearing Association (ASHA) highlights the importance of core vocabulary in supporting spontaneous novel utterance generation

otherwise known as SNUG

(<http://www.asha.org/public/speech/disorders/CommunicationDecisions/>). Core

vocabulary allows the individual to create a variety of spontaneous utterances which facilitates increasingly complex and more generalized interactions without the use of preprogrammed phrases with little variation and flexibility.

Vocabulary (Symbol) Animation

Given the need to ensure robust vocabulary and consistent expansion of linguistic abilities, choosing and selecting iconic vocabulary can be expanded to other attributes. Symbol animation has been a topic of research and transparency over the past decade due to the advances in communication software and hardware. Although it would be easy to assume the animation of symbols would be a strength of most dynamic display systems and iconic vocabulary, the animation process has had mixed results in improving icon transparency (Schlosser, Shane, Sorce, Koul, Bloomfield, Debrowski, DeLuca, Miller, Schneider and Neff, 2012). Jagaroo and Wilkinson (2008) wrote a paper where they discussed the use of motion dynamics to improve AAC outcomes for dynamic display users. They postulate that, “movement can help convey functional properties of objects, relationships between the objects in a scene, and causal patterns in kinetic action” (p.34). We can also pose a potential relationship between selective attention and working memory. Motion can and does draw one’s attention to a specific target. What it may not be able to do is support sustained attending to interpret, integrate and develop more complex understandings of the icon within a particular context or as an isolated function. Consideration should also be given for the amount of additional working memory and cognitive processes required to manage the animation or motions in relationship to

making connections to additional icons to convey a communicative message. Schlosser et al. (2012), studied typically developing 3 year olds using a mixed group research methodology. They looked specifically at symbol transparency along with name agreement and accurate symbol identification (p.348). They found that animation directly impacted the accuracy of naming verbs specifically but had little impact on prepositions (p.355). Mineo, Peischl and Pennington (2008) conducted research on animation with typical preschoolers looking at both static and animated icons. On broad level, children tended to respond better to the animation or video representation than they did the static icon (p.167). Both Schlosser et al. (2012) and Mineo et al. (2008) found that the ability to acquire vocabulary both through static and animated forms increased with age. This is important to consider in how we look at and assess vocabulary acquisition in relationship to one's cumulative experience, developing linguistic abilities and integration of knowledge with age.

Display Organization

Learning demands of the AAC system are also impacted by icon transparency along with display organization. Learning demands include the effort it takes the child to learn where the vocabulary is located as well as the effort required to access the vocabulary and develop more complex communicative exchanges. How the language is organized in an AAC system must consider a number of factors including the social context in which it will be used. Most displays use a series of rows and columns to organize the vocabulary. This is in contrast to scene based displays which may picture a specific room in a home such as a kitchen and have a variety of interactive comments

highlighting vocabulary and function. To begin with, let us consider the most common display format of columns and rows.

There are many ways to organize vocabulary within the column and row structure. This includes the number of available icons at any one time displayed on the screen. Taxonomic displays organize vocabulary based on specific categories and expand vocabulary based on the number of categories as well as the vocabulary within each. Schematic organization looks at specific routines and activities. Expansion occurs in a similar fashion to that of taxonomic displays. Thistle and Wilkinson (2015), surveyed 112 SLPs looking specifically at the decision making around AAC display design. They found that grid based designs were used most often with a strong focus on the consistency of the vocabulary display to improve connections and to capitalize on motor planning (pp. 130-131). Motor planning and display consistency can facilitate reduced learning demands including reducing the overload of working memory.

Light, Drager, McCarthy, Mellott, Millar, Parrish, Parsons, Rhoads, Ward & Welliver (2004) examined the learning demands of different display organization methods on typically developing preschoolers. They conducted two separate studies, which integrated evenly both concrete and abstract concepts. They included both grid and scene based displays in their research studies. One key finding which should be noted when considering various organizational methods is that, “the differences between the three dynamic display systems were not statistically significant.... Error analysis showed that most of the children’s errors occurred because they did not select the correct page to locate the target vocabulary item” (p.18). This can be juxtaposed with Drager, Light, Speltz, Fallon & Jeffries (2003) study looking at grid and scenic based vocabulary

acquisition in typically developing 2 ½ year old children. This study found that schematic scene based organizations produced much better overall results in vocabulary acquisition. They offer two possible explanations which consider both the learning demands and working memory components of the AAC display. In scene based displays, words become a part of the context and are not seen as isolated and disconnected. They suggest that, “this may be more similar to the conceptual maps of children” (p. 306). In addition scenes allow for more direct identification and location of specific vocabulary versus the more typical grid display.

Scene based display designs have become increasingly popular over the past five years and have emerged within the influx of tablet applications as well as the more formalized advanced communication device displays. One important distinction mentioned by Drager, Light, Carlson, D’Dilva, Larsson, Pitkin and Stopper (2004) and Drager, Light, Speltz, Fallon & Jeffries (2003), regarding scene based vocabulary is the way in which the symbols are used to interconnect and represent concepts on a single page and scene, versus more abstract single connections between pages, resulting in the possibility of reduced the metalinguistic demands. With the potential of reduced learning demands and increased interconnections, we need to consider the impact on selective attention and working memory demands as well. Wilkinson and Light (2011) studied the visual attention to human figures within scenes using college students. Their results indicated that on a broad level, individuals tend to focus on human figures even when other distracting stimuli are present in the photograph (p.1653).

AAC displays, vocabulary, symbol transparency and learning demands play a key role in the communication and vocabulary acquisition of students who require the use of

AAC supports and systems. This includes the role of working memory and selective attention in accessing such systems and maintaining connections with these individualized systems over time. The subsequent review looks at a specific method and display design which addresses each of these areas through a new lens and is the subject of this research study.

Language Acquisition Through Motor Planning (LAMP)

Language Acquisition Through Motor Planning (LAMP) is a method that supports AAC users and is considered relatively new to the field of practitioners and researchers. It was developed by John Halloran, MS, CCC-SLP, Cindy Halloran, OTR/L and Mia Emerson, M.S., CCC-SLP in response to the needs of the students they saw in their practice who required AAC supports. Halloran and Halloran (2006) found, “that giving individuals access to core words on a speech-generating device, teaching those words in sensory-rich activities, and accessing each word on the device with a consistent, unique motor pattern provided a means for developing independent communication” (p.1). There is very limited research on this approach and display system. As a result, this review will include both the current research available as well as related research associated with each of the LAMP components. To better understand how LAMP applies to student with complex disabilities, the discussion includes research and theory from the field of Deafblindness, psychology (Dewey) and neuroscience.

To begin, it is important to clarify how the LAMP method supports the six tenets from the National Joint Committee on the Communicative needs of Persons with Severe Disabilities (NJC, 1992). The organizational and operational demands of the LAMP method are intended to enhance communication efficiency and language development

including the expansion of communicative utterances (Naquib, Bruck & Costley, 2015; Giangrasso, 2015; Halloran & Halloran, 2006; Potts & Satterfield, 2014). This supports social-communication, the ability to engage in a variety of communicative acts and the development of skills to facilitate the use of a variety of communication functions. Exposure to rich and robust vocabulary in a predictable manner provides the necessary access to both language and communication to support full participation (Teachman & Gibson, 2014). The emerging LAMP method capitalizes on natural contexts and spontaneous interactions using consistent motor planning and vocabulary which includes varied word forms, word parts and a screen keyboard. This structure supports engagement across a variety of routines, communication partners and environments. To understand how the LAMP method presumes to provide such supports, each component will be reviewed in detail.

It is important to contemplate the components of the LAMP method as they relate to the development of communication skills and language, teacher interactions and the unique characteristics of students with complex disabilities. Language Acquisition through Motor Planning has five basic components; “(1) Readiness to Learn, (2) Shared Engagement, (3) Auditory Signals, (4) Natural Consequences, and (5) Consistent Motor Patterns” (Potts and Satterfield, 2013. P.2). The LAMP method provides a unique intervention method to support students who use AAC. The systematic combined use of each of these five components is intended to provide a more efficient and naturally reinforcing method of communication and language development. To understand how these components support language, a discussion around the types and qualities of experiences children with more complex disabilities have is needed.

Children with more complex disabilities often struggle with motor movements which support natural fruitful engagement with the world. Movement and action are associated with language development long before the child becomes symbolic. The teacher must co-actively stimulate these movements and movement patterns. That is, the student is gently guided through systematic motor sequences within the context of a learning experience where joint attention and turn-taking are facilitated. This approach originally described by van Dijk, is the foundation for the concept of LAMP (Potts & Satterfield, 2013, p.2). It is considered child directed, based on shared experiences through joint activity. For children who may not develop typical spoken language and will require augmentative and alternative communication, this foundation of shared experiences, the development of presymbolic meaning and the continual reinforcement of actions becomes critical to the path of effective language and communication. Cozolino & Sprokay (2006) describe neuroplasticity in terms of the brain's ability to "adapt and readapt to an ever changing world" (p.11). Jan van Dijk's original approach to learning and language through these rich repetitive interactions did not initially have this as its foundation, but was able to later add to the theoretical basis of his concept based on this more recent research. In his 1999 speech he noted that, "Modern neurobiological findings show that when the neurobiological system is faced again and again with the same sequence of events and is therefore able to anticipate the next one, the condition is favorable for the growth of the natural pathways" (<https://nationaldb.org/library/page/93>). The premise of repeated experience, motor planning and action, leads to the next piece in the unique development of language for those with more complex disabilities.

LAMP: Readiness to Learn

The first component of the LAMP method are readiness to learn (Potts & Satterfield, 2013. P.2). Beginning at birth, the child engages in the constant ordering and recontextualization of their world to make meaning. This is facilitated by adults who act as interpreters of events and experiences. Readiness involves building the relationship needed to enter the child's world, bringing them to a place of shared experience and engagement. Expanding upon experience, shared interests and developing what Dewey would refer to as "habits" of learning is key in developing stronger vocabulary, attending and improving what has been previously discussed as working memory. Freeman-Moir (2011) point out that, "Dewey begins by emphasizing the active role of habit in using and assimilating the environment. Habits involve sensorimotor skills, craft, and cunning as well as objective materials in the environment" (p. 209). The development of "habits" is a critical piece to the acquisition of language for students with more complex disabilities, especially those who require the use of augmentative and alternative communication. The "habits" encompass both the readiness and the shared engagement components of the LAMP approach. They build on automaticity, thus reducing the learning demands and capitalizing on the cognitive resources of the AAC user.

LAMP: Shared Engagement

Shared engagement is directly connected to readiness to learn. Mutual regard, joint attention and turn-taking are embedded in experience within a social context. Through shared engagement, the child can make both direct and indirect associations. Koopman (2007) points out the characteristics of temporality and historicity in experience developed by Dewey. "By temporalizing experience, however, we can

redescribe knowledge as a relation holding between prior and future experience” (p.711). Shared experience is both temporally and historically based. Children with complex disabilities require constant mediation within the context of shared engagement. Through mediation, the experience becomes predictable and organized, facilitating active engagement through co-active interactions. The resulting change facilitates reflection within the child, and is the bases for understanding and language. The biological basis to this premise can be found once again in the concept of neuroplasticity. Cozolino and Sprokay (2006) suggest,

The narratives that people construct in dialogue support memory function and serve as a guide for future behavior. Intuitively using a combination of language, empathy, emotion and behavioral experiments, the most successful teacher/mentors promote neuroplasticity and network integration. (p.13)

Repeated shared engagement and mediation is powerful. It brings together the elements of the world which will lead to in-depth understanding, thinking and inference which can be accessed at future times. Prior and future experience must be woven together in this manner for children with more complex disabilities to enter a world where they have the skills to actively engage, instead of passively spectate.

LAMP: Auditory Signals

Auditory signals are the third component and involve one of the primary distance senses. The concepts behind auditory feedback is that the AAC user will receive similar signals to that of a child using spoken language. The reinforcement of this auditory feedback supports attending to and understanding of the spoken language used within the environment. It is here we must consider one of the significant limitations of this

approach. Auditory signals assume functional hearing including efficient auditory processing. Many students who require augmentative and alternative communication do not have the consistent ability to make use of auditory information. This does not preclude the use of the approach, as the main premise focuses on repeated motor patterns in the acquisition of language. It is however, an important consideration which must be addressed during interactions and considered relevant when supporting the development of meaning through experience. Dewey might address this by reminding us of the importance of the repetitive interactions and continual feedback needed by the child to make sense of their world. Dewey does not specify what modality this must happen in, but rather it must be immediate and ongoing. Jan van Dijk would agree with this statement and add to it by reinforcing the concept of arousal. Arousal indicates a level of readiness to learn which is accessed through multisensory channels, not exclusive to auditory information only (van Dijk, 1999). MacFarland (1995) discusses vibrational-sound induced strategies to encourage the use of residual hearing including vibrational input. These particular strategies, “encourage auditory conditioning and attentive behaviors in the context of meaningful activities that occur in natural settings and are often combined with coactive movement sequences, coactive manipulation, nonrepresentational reference, and imitation strategies” (p. 227). Selective attention through motoric cues was studied by Swinehart-Jones and Heller (2008). They looked at the use of a motoric based decoding strategy for students with physical impairments. “When teaching the decoding strategy using guided practice, each participant appeared to decode the targeted word, as observed through their use of motoric indicators and additional behaviors” (p.141). This guided practice to the students which may be

compared with the co-active interactions described by van Dijk as well as the characteristics of interactions described by Dewey.

LAMP: Natural Consequences

The fourth component of the LAMP approach is the use of natural consequences. For children to make sustained and developed connections from which language forms, there must be a powerful consequence associated with each action or set of actions. This supports Dewey's concept of reflective experience. AAC users develop patterns of engagement which may be directly reinforced by the actions associated with the direct selection of an icon to achieve an end. Cozolino and Sprokay (2006) point out the unique combination of sound and motor patterns used in the LAMP system. "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" (p.3).

LAMP: Consistent Motor Patterns

The development of language through the use of consistent motor patterns is the foundation of the LAMP approach. Motor patterns are embedded in the use of icon based augmentative systems. Icons are placed in specific locations to produce a series of consistent unique motor patterns in the selection process. The meaning associated with each icon is not directly taught. Language associations occur through the motor movements and patterns. According to the Aspect LAMP Research Report (2013), the use of motor patterns is beneficial because, "it decreases the need to learn the meaning of a symbol and allows access to a larger vocabulary that is accessible through short motor sequences" (p. 3). The hope is to achieve automaticity in these motor patterns to

increasingly expand upon language and engagement. The focus is on the development of motor patterns before understanding of specific iconic symbols. Galantucci, Fowler and Turvey (2006) in their analysis of motor theory and speech perception stated, "...there is reason to believe that perception is particularly attuned to the general anatomical and dynamical constraints on biological movements, as well as to the specific subtleties of individual movements" (p.371). Neuroplasticity certainly has a role in motor planning as it intercedes the development of language. Our brain is a dynamic organism. Berlucchi (2011) considers the following; "Behavioural analysis leaves no doubt that during the lifespan the nervous system must be unremittingly adapting itself to changing conditions..." (p.562). Adaptation is a mitigating factor in language development through motor planning. The brain is constantly adapting to the input received from repeated motor experiences which are situated within joint engagement, and provided with natural consequences to reinforce understanding and meaning.

Consistent use of motor patterns in communication may assist the child in anticipating responses and outcomes based on such movements for both themselves and others. Modeling the use of these motor movements for icon selection within the context of an interaction is critical for the development of meaning and understanding. That is, the teacher or communicative partner must also use the child's AAC system when mediating joint engagement. The AAC system used throughout all aspects of the child's day provides the repeated collective experiences to form motor habits which are reinforced through natural consequences. MacFarland (1995) points to expansion when, "Movement sequences continue to be used within the student's daily educational and living routines. Gradually these routines become more complicated as the student masters

the skills needed for the activity” (p. 226). It is here that we see the development of selective and reflective attention, greater self-action and the establishment of increasingly complex habits.

Teacher Interactions

Identification of Communicative Acts

How teachers recognize, respond to, and identify communicative acts are key in supporting language and communication for students with more complex disabilities through daily interactions. These interactions are generally unique each time and responsive to the intentional and unintentional communication students engage in. To begin to understand how teachers engage with AAC during interactions with students, we must look more closely at the narratives which are created within the communication dyad. How teachers imply intentionality and respond to communicative acts has been a central feature of the research. The ability to distinguish between intentional communication and emerging communicative acts is part of the judgments teachers must make each day (Carter & Iacono, 2002; Keen, Woodyatt & Sigafoos, 2002). Intentional communication occurs when children or adults realize that what they do has a direct impact on the responses of others. An example would be a child pointing to a toy out of reach or bring an adult to a toy in order to acquire it (<http://praacticalaac.org/>). When looking at both intentional and emerging communicative acts it is important to consider how these studies look at teacher interactions and use specific methodologies to answer research questions in this area. Sets of studies will be juxtaposed with careful examination of the differences in the questions asked as they relate to the identification of communicative acts and the communication dyad itself.

Carter and Iacono (2002), constructed the problem by identifying the need to look more closely at how the development of intentional communication occurs (p.178). Their research used a combination of special educators and speech language pathologists. By using videotaped recordings which were viewed by both the teachers and the speech pathologist as well as a structured three-part form, they were able to look more deeply at how communication was recognized (p. 182). Keen et al. (2002), addressed communicative intentionality and the identification of communicative acts by teachers slightly differently, looking at how teachers attribute specific forms of communication to children (p.134). Both of these studies assumed the use of established linguistic and prelinguistic criteria would allow them to measure and validate the types of communication behaviors acted upon by teachers as intentional communication.

Other studies approached the identification of intentional communication quite differently including how they looked at and defined communicative acts and how the communication partner supported such acts. Bunning, Smith, Kennedy and Greenham (2013), completed a study in the United Kingdom, in which they examined the communication interface between educational staff and students with severe to profound intellectual disability and multiple disabilities, making the individualized nature of this construct problematic (p. 39). They drew upon a mixed methodological approach which used video tape, field notes and a specific coding procedure to examine the communication dyad. Soto, Hartmann and Wilkins (2006) and Naraian (2013) examined the communicative dyad but have a stronger representation of the social context and environment. While using a case study (Soto et al., 2006) and ethnographic methodology (Naraian, 2013), they examined the unique qualities of individual interactions which

supported communicative acts and the identification of intentionality. These studies assumed that the interactions between the teacher and the student are unique and complex each time they occur. They assumed there are features and ways in which teachers engage with students which can be described and used to understand how teachers use their knowledge, experiences, and relationships with the student to support communication.

How teachers, often including speech language pathologists view communicative “acts” has been examined by the research with several inconsistencies and conflicting results found across studies (Bunning et al., 2013; Carter & Iacono, 2002; Keen et al., 2002; Naraian, 2013; Soto et al., 2006). The studies examined teacher behaviors through a variety of qualitative methods described previously. Researchers looked deeply at the ways in which teachers engage in AAC within the communicative dyad itself. Findings have been mixed across studies in relationship to the agreement in what constitutes a communicative act and the relevance of established criteria to measure it by. To place this in the larger conversation and to highlight the importance of this, we must consider how prelinguistic and linguistic communicative acts emerge through the use of AAC within the context of teachers as communicative partners as described by the present studies.

Communication Dyad

Augmentative and alternative communication provides the means for which communication and language are mediated. Teachers, as a member of the communication dyad, play a central role in reinforcing, co-constructing and interpreting the language and communicative acts which occur during these interactions. They facilitate, model and

actively engage in the AAC system as a natural part of the school routines, both formal and informal. The social context of the interaction becomes integral when discussing research findings. Naraian (2013) described this as she discusses the social threads within the communicative environment, “Any description of Trevor (student) would be inseparable from the relationships with others within his community – adults and peers” (p.256). Thus, how teachers imply intentionality and interpret communicative acts is inseparable from the unique social context in which the interaction occurred (Soto et al., 2006; Naraian, 2013). The interpretation of such communicative acts requires an understanding of those acts which begin as behaviors which require the assignment of intentionality versus those which are committed as intentional forms of communication.

Assigning intentionality becomes one part of the social context in which teachers engage with AAC. Four of the studies looked at this in more detail. Carter and Iacono (2002), found that, “special education teachers tended to assign intentionality to segments chosen to demonstrate intentional behavior, nonintentional behavior, and ‘fuzzy’ communicative acts more frequently than did speech pathologists” (p.182). The studies indicated that although some communicative acts identified by the teachers met researcher criteria, others only partially met criteria or did not meet criteria at all (Carter & Iacono, 2002; Keen et al., 2002). These inconsistencies demonstrate some of the inconsistencies in the ability of a given teacher to distinguish between intentional behavior and intentional communication. Bunning et al. (2013) found that even when communicative acts were present, teachers tended to dominate the interactions and direct the communication. However, even in the context of what has been described as “teacher dominated”, the... “communicative functions employed by the teachers enabled the

students to make responses despite a restricted repertoire, using smiling, laughter and other vocal behavior to contribute to the interactional sequence” (Bunning et al., 2013, p.48). Thus, although the intentionality implied within the communicative dyad was directed more by the teachers, the student was able to engage in a meaningful way. The dominant role in the communicative dyad may at times act more as a means of facilitation which becomes sensitive to the intricacies and variation in interactions within a specific social context. This is reinforced by Soto et al. (2006) who states that, “Communication partners can use contingent queries and verbal redirection to indicate that a narrative was not explicit enough but with extreme attention to not overtaking the conversation” (p.239).

Facilitation of Interactions

How teachers facilitate interactions has been explored as a function of teacher knowledge which is co-constructed within the communication dyad. Two studies addressed the skills and knowledge teachers may possess, and how these skills and knowledge inform the interactions within the relationship of each communication dyad. These studies used slightly different methodologies in looking more extensively at how teachers engage with AAC and the inimitable knowledge and skills they bring to the communication dyad. Korkiakangus and Rae (2013), a study conducted in the United Kingdom, used conversational analysis methodology to analyze the behaviors teachers use to manage and engage students during activities (p.83). More specifically, they looked at how teachers used objects and specific behaviors as a form of communication to facilitate attending, understanding and active participation in educational activities. Trief, Bruce and Cascella (2010), using detailed teacher records, constructed their

research by looking at of how specific symbols were chosen and mediated by teachers to facilitate communication, participation, and understanding within educational routines (p.499). Each study assumed that the practices and judgments made by the teachers influenced the facilitation of communication, understanding, and participation for each student.

Korkiakangas and Rae (2013) described the way teachers used specific practices and knowledge explicitly in their study, "...rather than suddenly requiring the child to act in a certain way, the teacher's conduct has a progressive character, such that the child's involvement can be monitored and gauged on the way to arriving at the place where his or her co-participation is relevant [through the use of objects] (p.87). How objects, symbols and tangible symbols have been used, identified for use, and integrated into routines, provides insight into how teachers use knowledge and specific practices to facilitate communication and participation in the everyday interactions experienced by students (Trief et al., 2010; Korkiakangas & Rae, 2013). This is reinforced by Trief et al. (2010) who focused on the use of standardized tangible symbols by teachers to meet the very individualized needs of students with more complex disabilities. As a result of the study, one of the major findings demonstrated how teachers use their knowledge and engage in specific practices when making individualized specific choices involving the selection of tangible symbols for a child. "The most important practice implication from this study is that there are tangible symbols that educators find important to use with children at different ages" (Trief et al., 2010, p.503).

The way this knowledge and skills emerges in practice highlights the intricacies within interactions teachers have with students that involve constant recontextualization

and facilitation of language and communication within a specific social context. This dynamic interaction is captured through the common shared routines which occur throughout the day. These routines provide the opportunity to look deeply at the ways teachers make subtle adjustments to facilitate interactions and participation. According to Korkiakangas and Rae (2013), “The areas of difficulty for the child, as well as his or her competent understanding of the object mediated interactions, could be captured through the close examination of mundane interactions, where participants demonstrate their own treatment of each other’s eye-gaze and the movement of hands, bodies, and material objects” (p.101). Teachers are able to refine their responses using the materials and objects available to facilitate interactions, language, and communication in ways which are subtle, yet deliberate, as part of each unique communication dyad as defined by the dynamic social context in which it exists.

When we consider the findings of these studies, several key understandings emerge. First, how teachers interpret, reinforce and understand communicative acts is a central component in how AAC is facilitated. This interpretation and facilitation occurs during well-defined interactions, as well as within interactions involving emerging communicative intent (prelinguistic), as opposed to defined linguistic ability using established criteria. Teachers may imply intentionality based on previous experiences within a shared social context. This act of intentionality evolves as the communication dyad constructs, recontextualizes and then co-constructs meaning. Inconsistencies were found based on established criteria (Carter & Iacono, 2002; Keen et al., 2002). These findings can be juxtaposed with Bunning (2013) and Soto et al. (2006) where teacher directed interactions facilitated communicative acts, creating a narrative where

intentionality was implied in functional ways. There was not a distinction between implying intentionality to communicative acts that met a specific criteria, rather, each time the teacher engaged with the student, communication was assessed and described based on the unique social context within the confines of the communication dyad. This provides a slightly different perspective and understanding when looking at how teachers engage with AAC on a prelinguistic and linguistic level. Part of the differences in the findings is a function of the way they constructed the problem, methodologies used and assumptions.

Carter and Iacono (2002) and Keen et al. (2002) presumed that communication acts could be framed and measured using established criteria and made problematic the teacher's ability to match specific student behaviors to this established criteria. Bunning (2013) and Soto et al. (2006), looked deeply into the communication dyad itself, assuming that communication was dynamic, individualized and facilitated by the unique ways teachers and students respond to each other. Although on the surface these contrasting views may seem quite different, they are in fact looking at how teachers engage with AAC through different procedural constructs, attempting to interpret and define what we know in a manner which informs our knowledge and practice. They provide interconnecting pieces which fit within the intertwined intricacies of human interactions, which could never be adequately examined by a single set of assumptions, or captured by only certain methodological approaches.

The second connected understanding looks at how teachers use specific skills and knowledge to mediate communication across commonly occurring routines and activities. Looking more deeply at the communicative acts which are directly mediated by the

teachers within the social context, the studies illustrate that one cannot separate the actions of the teacher from the actions of the students. Teachers make decisions on how they will engage with AAC based on the individualized nature of the communication dyad as it is constructed within a common routine or interaction and mediated by objects which facilitate shared meaning and understanding between the teacher and the student (Trief et al., 2010; Korkiakangas & Rae, 2013; Naraian, 2013).

Teachers prioritize how communication will be facilitated and how AAC will be used. This cannot be separated from their own personal perspectives, views and attitudes towards the use of AAC which directly impacts how they engage with it. It becomes a very messy construct of competing ideals, acts and logistics. Naraian (2013) puts this into perspective, “As Trevor participated in his social identification within the classroom, the use of AAC technology in that process remained a conflict ideal among many adults who served as facilitators” (p.257-258). This leads into the next interconnected theme; teacher perspectives, attitudes and beliefs.

Teacher Perspectives, Attitudes, and Beliefs

The section on teacher perspectives, attitudes, and beliefs has been divided up into three smaller areas which include; positive assumptions, barriers and identified needs. The methodologies used in the seven studies under this theme are quite mixed (qualitative and mixed method) and do not share many common approaches. However, they do share a common assumption, that teacher perspectives, attitudes, and beliefs impact engagement with AAC and student outcomes. They study the use of specific interventions, technology, and AAC systems, proceeding to identify barriers, assumptions, and needs associated with the use of AAC.

Positive Assumptions

To begin, let us look at some of the positive assumptions made by teachers regarding engagement with AAC. Teachers identified positive outcomes associated with the use of AAC (Bruce, Trief & Cascella, 2011; Dada & Alant, 2002; Johnston, Nelson, Evans and Palazolo, 2003; Stoner, Angell & Bailey, 2010). Studies examined the implementation of AAC systems to describe attitudes and beliefs by team members, including general and special education teachers as well as speech language pathologists. It is important to note that two of the studies used inclusive educational settings or drew upon staff who supported students within inclusive educational settings (Johnston et al., 2003; Stoner et al., 2010), one study, Dada and Alant (2002) used teachers from both inclusive and separate settings and Bruce et al. (2011) surveyed special educators and speech language pathologists in four schools within an urban setting. This provides some evidence for the more recent shifts in public policy around inclusive settings and the use of AAC in the United States and also articulated by other countries such as South Africa as identified in the Dada and Alant (2002) study. The methods used by these studies are diverse as mentioned earlier. Stoner et al. (2010), used a case study approach to examine and describe team member perspectives on AAC (p.122). They focused on the ways in which team members viewed the use and implementation of AAC within an inclusive high school setting. The research was based on a single student and framed within the context of how team members engaged with AAC specifically to support one individual student. Johnston et al. (2003) used a multiple probe design, constructing their three questions to look at the effectiveness of a specific AAC method, the generalizability to other activities, and the “perceived effectiveness” by teachers (p.88). Here teachers were

actively involved in the implementation of AAC and were provided with specific training in how to engage with the AAC strategy while working with three preschool students. The study assumed training could be an influence on the perceived effectiveness and overall attitudes and beliefs which are described at the end of the study.

Bruce et al. (2011) examined the supports and barriers to student learning while engaged in a specific AAC intervention. Participants were provided with training and then interviewed to look more deeply at what participants felt were beneficial, potential barriers, and additional needs to improve the outcomes of the intervention (p.174). Finally, Dada and Alant (2002) sampled a much larger number of teachers from both inclusive and separate schools. They used a combination of videotapes of particular students in combination with the Teacher Attitude Scale (TAS). Teachers did not engage in direct instruction. Attitudes, beliefs and perceptions were rated based on watching a specific video of a student engaging with AAC followed by completion of the TAS (p.214). This study drew on broader themes in attitudes which were not directly connected or placed in personal context of the communication dyad and daily teacher interactions. However, it is important to remember that the study addressed a much broader perspective on teacher attitudes to engage in a public policy discussion versus an intimate description of the communication dyad. It assumed that teacher attitudes influence their view of student engagement with AAC as well as influencing their value and willingness to use it. The varied methodologies and the way each study examines teacher perspectives, attitudes, and beliefs, helps us to construct the scope of what we know in this area on both a local and more national or international level.

Stoner et al. (2010) found that the “Analysis of staff interviews yielded the following facilitators of Joey’s AAC system use: (a) teachers’ willingness to implement device usage; this willingness stemmed from their student focused paradigm...” (p.129). The willingness to implement AAC was irrespective of the type of system used (Dada & Alant, 2002). Teachers saw the value of AAC and identified such factors as increased student engagement (peers and staff) and increased access to learning (Bruce et al., 2010; Johnston et al., 2003; Stoner et al., 2010). The value seen in using AAC outweighed the amount of additional work which was needed to effectively implement and sustain the AAC system (Johnston et al., p.97). How supported teachers felt played a strong role in their beliefs, attitudes and perspectives. Teachers who felt positively about engaging with AAC viewed themselves as part of a team and saw that a team approach was needed to access the benefits of an AAC system (Dada & Alant, 2002; Stoner et al., 2010).

These studies highlighted the multifaced characteristics, beliefs and training needs which can impact teacher interactions, identification of communicative acts and the consistent use of AAC systems. Teachers interactions are central to the ongoing implementation and expansion of a student’s AAC system. These key areas lay the framework for some of the common barriers which are discussed in the next section.

Barriers

In contrast, collaboration and team work was also viewed as a barrier to successful implementation and engagement with AAC systems (Mukhopadhyay & Nwaogu, 2009; Pufpaff, 2008; Stoner et al., 2010). Mukhopadhyay and Nwaogu (2009) and Pufpaff (2008), specifically studied the barriers identified by teachers and team members while engaging in AAC. Focus groups were used including a qualitative

interview methodology by Mukhopadhyay and Nwaogu (2009) who conducted their study in Botswana. They focused their research on how teachers, “understood the challenges of teaching non-speaking learners with intellectual disabilities and the scope of augmentative and alternative communication (AAC) used in primary school settings...” (p.349). Only special educators were included in the study. The teachers served students in public school settings, but were located in substantially separate classrooms. This is important to consider when understanding the research findings. As a source of comparison, Pufpaff (2008) has been included. This study is the first study, “to explore the participation of a student with AAC needs in a balanced reading program within a general education environment...” (p.585). Here the researcher addressed the use of AAC within the general education environment and clearly articulated the assumption that the only way to get at a more holistic view of the barriers, was to use an interpretivist paradigm which integrated a series structured and unstructured interviews which were integrated with the data from observations (p.585). Finally, Rupper, Dymond and Gaffney, (2011) used a survey method to specifically examine, “teachers’ beliefs about literacy instruction, preferred interventions and settings for literacy instruction, factors influencing their preferences, and perceived barriers...” (p.102). The survey included teachers in both inclusive and substantially separate classrooms. These studies provide key perspectives as seen across varied school settings, along with a spectrum of highly individualized perspectives placed within the broader collective trends and understandings.

Several key findings highlight this important topic. Pufpaff (2008) cited “the lack of collaboration among key personnel resulted in (a) minimal planning and preparation

for William's integration..." (p.587). Planning and preparation is essential and quite extensive when effectively implementing and engaging with AAC systems. The challenges and additional requirements associated with supporting students with complex needs underscores the scope of time and commitment needed. Mukhopadhyay and Nwaogu (2009) found that teachers consistently articulated the need for assistance from team members pointing out that, "From the comments made by teachers interviewed, it was clear that teaching nonverbal students with an intellectual disability required additional work and responsibilities" (p.355).

An extension of the collaboration or team process barriers are the opportunity barriers. Here we can examine how perspectives, attitudes, and beliefs, which can create positive opportunities as stated earlier, can also prevent access to consistent opportunities to engage with AAC. These opportunity barriers impact access to content, access to a variety of communication partners, and to appropriate interventions. Literacy instruction is a high priority for students, including those who use AAC. Opportunity barriers exist for a number of reasons in this core academic area. Mukhopadhyay and Nwaogu (2009) stated that, "...a majority of the teachers felt that AAC could be used only for functional communication. One of the participants succinctly asked, 'How can you use it for developmental reading? I don't think it is possible'" (p.355). Ruppert et al. (2011) looked at this in more detail and found differences in teacher attitudes based on the setting in which they taught (integrated vs. separate). "Teachers in integrated schools were significantly more likely to rate interventions related to the general education curriculum highly..." (p.105). When looking at literacy instruction more broadly, teachers across all settings were likely to choose skills related to life activities, daily living and other

routines which were considered functional over more traditional literacy instruction (Mukhopadhyay & Nwaogu, 2009; Ruppar et al., 2011). The studies identified the need for training in this area as one remedy to alleviate the barriers in opportunity imposed by these beliefs and attitudes.

Identified Needs

This leads into the third area under the broader theme of teacher perspectives, attitudes, and beliefs which include the areas of need. How teachers perceive their own abilities to engage with AAC is impacted by the type of training they do or do not receive (Dada & Alant, 2002; Mukhopadhyay & Nwaogu, 2009; Pufpaff, 2008). The studies consistently identified training as both increasing opportunities to engage with AAC as well as contributing to access barriers when it is not responsive to teacher and student needs. “Teacher training is therefore indicated to provide teachers with the intrinsic belief in their own abilities to perform the necessary actions that result in student learning “(Dada & Alant, 2002, p.215).

A second need identified, is the ability of a team of professionals to work together collaboratively to support the student, implementation of AAC and each other (Dada & Alant, 2002; Mukhopadhyay & Nwaogu, 2009; Pufpaff, 2008; Stoner et al. 2010). According to Stoner et al. (2010), “Yet, as skilled as he [student] was, he needed his team to be proactive in identifying challenges associated with the use of his device and, perhaps even more importantly, responding to these challenges” (p.131). Finally, within the team itself, clear role delineation is needed (Dada & Alant, 2002; Mukhopadhyay & Nwaogu, 2009; Pufpaff, 2008). Without clear team roles, responsibilities either were placed on an individual team member, went undone, or unidentified, resulting in

inconsistent implementation of the AAC which impacted the student's access to appropriate interventions and follow-up (Pufpaff, 2008).

The key understandings from the broader theme of teachers' perspectives, attitudes, and beliefs, describe the complex nature of engaging in AAC. First, we know that how teachers perceive their own abilities directly impacts their view of AAC and their perceived effectiveness in how they engage with it (Dada & Alant, 2002; Mukhopadhyay & Nwaogu, 2009; Pufpaff, 2008; Ruppar et al., 2011; Stoner et al. 2010). Second, collaborative teams with defined roles and responsibilities are a critical feature of successful engagement with AAC which lead to better student outcomes as perceived by those teams ((Dada & Alant, 2002; Mukhopadhyay & Nwaogu, 2009; Pufpaff, 2008). These findings and understandings add to the scope of what we know in the area of AAC. They inform our policy and practice by including both general and special education settings, as well as an international outlook, while considering both individual and broader group perspective and trends through larger scale surveys.

Collaborative Teams

A common thread among many of the studies and the third major theme, is the area of collaborative teaming for which the teacher (special and/or general educator) is a member. Seven specific studies were found to be reviewed under this theme each specifically examining collaborative teams as an important aspect of how teachers engage with AAC. The discussion of this theme will reference the student team, which will be defined as those professionals who provide direct or indirect services to a specific student. The teacher will not be separated from the team, as the focus of this set of reviews is on how the unique qualities of the team, including describing how it functions and engages in AAC.

Teams Sharing Knowledge

There are two central assumptions which will be explored in this section. First, is the belief that teams share knowledge and experiences, and that these experiences impact how they engage with AAC and the potential outcomes for the student (Hunt et al., 2002; Soto, Maier, Müller and Goetz, 2001; Sonnenmeier, McSheenan and Jorgensen, 2005).

Both of these studies took place in the general education setting and look at how collaborative teaming impacts the ways in which students who use AAC engage in the general education content. Each study addressed the ways in which teams of professionals associated with students who use AAC engage with each other to support students within an inclusive setting. Sonnenmeier et al. (2005) used a case study methodology to examine a specific model of collaborative team planning called the “Beyond Access Model” (p.101). They focused on one team supporting a single student within a rural elementary school (p.101). Hunt et al. (2002) examined three different teams each serving a student within an inclusive elementary school in an urban area (p.21). The “Unified Plans of Support” were made problematic, looking at how, “Curricular adaptations and modifications were designed to support the focus students’ full participation...” (p.22). The methodology included specific student outcome variables along with extensive team interviews at key points throughout the study (p.24).

Teams Engagement with AAC

A second key assumption found in five of the studies presumes that there are specific supports needed to successfully engage with AAC to facilitate student communication across environments. Four of the studies focused on professionals who worked within inclusive settings (Finke, McNaughton and Drager, 2009; Kent-Walsh &

Light, 2003; Soto, Maier, Müller & Goetz, 2001a; Soto, Müller, Hunt & Goetz, 2001b) while the one international study completed in South India, interviewed professionals from separate or private settings (Srinivasen, Mathew & Lloyd, 2011). Two studies used an interview methodology (Kent-Walsh & Light, 2003; Srinivasen et al., 2011) while the other three used focus groups (Finke et al., 2009; Soto et al., 2001a ; Soto et al., 2001b). The inclusion of students using AAC was made problematic (Finke et al., 2009; Kent-Walsh & Light, 2003; Soto et al., 2001a ; Soto et al., 2001b) with each study looking at specific issues, supports needed, and overall experiences of team members. Srinivasen et al. (2011) looked at the ways in which students were supported in using AAC within separate settings specializing in special education as well as the perceived value in using AAC (p.232).

The collaborative teaming process has been presumed to be essential in planning for the needs of students who use AAC. How this planning occurs must be explicit with key features (Hunt et al., 2002; Sonnenmeier et al., 2005). In addition, Hunt et al. (2002) found that, “The structure of the collaborative team process allowed members of the team to share knowledge, experience, and skills” (p.23). This shared set of experiences directly impacted student outcomes and the ways supports were evaluated, altered and re-evaluated. Sonnenmeier et al. (2005) provides an example of how these shared experiences impact the team’s ability to support students who use AAC. In their study which focused on an individual student, they cited that initially, “there was a misalignment between services and the team’s identified learning priorities for Jay... Many changes in service delivery were made as a result” (p.108). The ability to make ongoing adjustments is considered a critical feature of a collaborative team. In order for

this to occur, there needs to be consistent communication and planning (Hunt et al., 2002; Sonnenmeier et al., 2005). As a result of the implementation of the “Beyond Access Model”, Sonnenmeier et al. (2005) state that, “The team’s improved capacity for collaborative teaming resulted in more time spent on planning for and evaluating the student supports for communication and learning than had occurred in the past” (p.111). The ways in which the team members engaged with each other, impacted how they engaged with the student and resulted in better student outcomes. This alignment of student oriented goals and a shared direction, resulted in a more unified vision across team members.

The collaborative planning process which facilitates a shared vision, also assists in identifying and evaluating individualized, team and environmental supports and skills needed for successful implementation of a student’s AAC system. Soto et al. (2001a) and Finke et al. (2009) were able to look at this in much more depth through the use of a focus group methodology discussed earlier followed by research team consensus. Soto et al. (2001a) identified skills which fell, “under one of five major thematic headings: (a) collaborative teaming, (b) providing access to the curriculum, (c) cultivating social supports, (d) creating classroom structures that support learning of heterogeneous groups of students” (p.53). These skills were needed to provide adequate supports on both an individualized and group level to successfully implement AAC systems. The focus groups, which were made up of a variety of professionals which included any combination of the following; general educator, speech language pathologist, parents, instructional assistants and inclusion teacher evaluated their own roles as well. “Members

of all five focus groups expressed a need for flexibility around role boundaries for all team members” (p.55).

The implementation of AAC is individualized, systematic and requires careful planning and evaluation by teams to be sustained. This is further highlighted by Finke et al. (2009) who found that, “All the participants emphasized the need for collaborative teaming, including group identification of goals and instructional strategies, open communication between team members, and the need for all team members to have well defined roles and responsibilities” (p.120). Chung and Stoner (2016) examined ten studies on collaborative teams. Their findings highlight the personal characteristics of a team members that can actively contribute in a manner which positively impacts both the student and the team process itself. Effective communication and mutual respect led to greater collaboration amongst team members. Considering the findings of these studies, roles and responsibilities must be defined and flexible, and need to be carefully managed to address the intricacies of each communication system. It requires all team members to share knowledge and experiences, as well as develop a shared set of skills which can be drawn upon at any time.

Research findings about collaborative teams suggests certain understandings which influence policy and practice. First, Kent-Walsh and Light (2003) summarize the supports which have emerged which should be considered. In their findings, general educators made specific recommendations including; “...(a)maintaining team collaboration, (b) providing adequate training for all team members, (c) ensuring individual team members support general education teachers on an ongoing basis, (d) implementing effective transition planning, and (e) selecting AAC systems with functions

that are appropriate for individual students” (p.117). That is, there needs to be a systematic planning process which provides a structure for collaborative teams to develop, sustain, and respond to the unique AAC needs of an individual student. This must include planning time, training, support structures which value collaboration, and the ability to have role flexibility within the political structures of a district and school. This is a critical understanding for practice and in the development of policies within districts and schools who are in the position of providing the organizational supports for this to occur.

Education and Training

Throughout many of the research studies, the assumption that team collaboration along with training are critical elements to how teachers (and other team members) engage with AAC has been present. In the next section, nine studies will be reviewed under the fourth theme of education and training. Out of the thirty studies collected and reviewed, eighteen studies mentioned the need for training in their findings. The nine selected for discussion under the broader theme of training and education, highlight specific criteria and methods of training which are assumed to produce better understanding of how to engage with AAC, as well as to facilitate the development of the skills necessary to participate in the collaborative planning process. Included in these studies are training programs for para-educators or educational assistants who work directly with teachers, and who are often seen as one of the primary communication partners of students who use AAC. The nine studies have been divided up into two groups. The first addressed specific training of teachers and para-educators who were currently supporting students with AAC in their classrooms. These studies include

training on a particular approach or method which is presumed to support better student communication outcomes. The second group address specific preservice or inservice educational training programs. These studies assumed there are important components of a training program which lead to improved knowledge and skill development in the area of AAC.

Teacher and Paraeducator Training

To begin, studies associated with the training of teachers and para-educators to support immediate practice and improved communication interactions with students who use AAC were examined. Each of the five studies used different methodologies, all assume that specialized training is needed to improve the communication responses and outcomes of students who use AAC. In addition, they presumed that teachers must receive this specialized training in specific methodologies to engage effectively with AAC. Each examined the ways in which teachers, para-educators or teachers and para-educators engage with AAC to support the communication abilities of their students. Douglas, Light and McNaughton (2012) along with Binger, Kent-Walsh, Ewing and Taylor (2010), focused specifically on the training of para-educators. Both of these studies used a single subject design with multiple probes. The studies looked at the overall effects of para-educator training on the communicative responses of individual students using specific intervention training methods.

The additional three studies which investigate specific approaches, focused on teachers, and the combination of teachers and para-professionals. Foreman, Arthur-Kelly and Pascoe (2007), a study conducted in Australia, extended an earlier study which provide intensive training to in-service personnel. They used a case application approach

which, “required each dyad (teacher and aide) to work closely and systematically with one of their students, using the materials provided in the training program” (pp.235-236). A second international study was included from the Netherlands by Janssen, Riksen-Walraven, Van Dijk, Ruijsse-narrs and Vlaskamp (2007). Using a case study methodology, a systematic intervention involving both team and individual coaching was used to support teachers’ abilities to facilitate communication with their students (p. 678). This is a unique approach from the other studies as it approached the concept of training from a coaching model which frames the question and results in a slightly different manner. They specifically looked at the teachers’ desire to support their students in a more responsive and effective manner. They provided dynamic, but systematic support (education and training) based on the highly individualized needs of each communication dyad. Finally, Howlin, Gordon, Wade and Charman (2007), a study conducted in the United Kingdom provide a two-day workshop on the Picture Exchange Communication System (PECS), and evaluated the impact through a randomized group controlled trial (p.473). By using an immediate, delayed and no treatment group, they look to determine the impact of the PECS program on teacher implementation as well as the expansion of student communication skills (p.474). This study is unique, as it allows us to juxtapose the potential differences between providing immediate vs. delayed or no training at all, as opposed to the other studies which apply training and compare results to a baseline alone with no identified control group.

Training and Implementation of Specific AAC Approaches

Over the past fifteen years, there has been a focus on refining instructional approaches to better serve students with AAC needs. This section reviews the studies

related to the training and implementation of specific approaches, and the responses by teachers and para-professionals to such interventions, including the ways in which they engage with them. What is noteworthy about many of these studies juxtaposed to studies reviewed earlier in the teacher interactions section, is that they focus on the social aspects of communication as it is situated within the broader context in which it occurs. This shift in focus produces results which consider other features associated with how teachers engage with AAC. In particular, these studies looked at the communication dyad and how training and specific interventions impacted it. An example of this can be found in Binger et al. (2010) quoting from one of the para-professionals, “‘It gives me the experience to be able to teach this with another student,’ and ‘It helped the student and I have a stronger bond...it was fun’” (p.115). Following the training provided to the para-educators, student communicative responses expanded and were used more consistently (p.117).

This finding is reinforced by Douglas et al. (2012), Howlin et al. (2007), and Janssen et al. (2007), who found increased rates in communication opportunities and behaviors following training and consultation. Foreman et al. (2007) finds that as a result of training, there was an increase in knowledge and skills which, “...indicates a reported improvement in the abilities of teachers and aides...” (p.239). This is similar to the findings of Janssen et al. (2007) who report that, “During the evaluation, Nicole’s (student) educators indicated that they had improved their skills in establishing reciprocity (turn-taking) in interaction by confirming and by regulating” (p.683). The coaching model of intervention included both team and individual coaching to engage teachers and the student within the context of the dyad in a manner which was facilitative and highly individualized to improve AAC outcomes, while developing the necessary

skills and knowledge of the teachers. The assumption in the findings is that the training or coaching provided had a direct impact on the number of opportunities available for students who use AAC to be engaged. This was irrespective of the interventions used. These studies focused on supports provided within the context of practice, addressing the communication dyad, social-context of communication, and the types of opportunities available for students to engage in AAC.

Professional Development and Education Programs

Connected to the focus of specific interventions is the more formalized teacher and professional educational programs which are currently a priority for policy and practice as discussed in the initial positioning of the question of how teachers engage with AAC. Four studies specifically address this issue. Anderson (2011) examined the professional learning experiences of teachers working in Scotland through the use of questionnaires distributed to 49 teachers (p.9). She addressed how teachers perceive and engage in professional development in the area of AAC looking at more of the informal learning which occurred in the context of everyday practice. This is in contrast to a study completed by Patel and Khamis-Dakwar (2005) who examined a specific training program for Palestinian Arab teachers in Israel (p.205) and Robinson and Sadao (2005), who looked at the implementation of a person focused learning method to address the needs of AAC professionals. Patel and Khamis-Dakwar (2005) used a questionnaire which was administered pre and post training along with videotaped interviews. The purpose was to look at the impact of training on the teachers' ability to use AAC and to address potential barriers (p.205). Robinson and Sadao (2005) used an eight-step process which addressed the development of coursework, specific activities and the direct

feedback of families and persons with disabilities (p.152). They focused on the lack of input by families and persons with disabilities into how professionals engage with AAC. Finally, one study was found which looked specifically at how team members (including teachers) engaged in learning AAC, in particular, the higher technology forms.

Beukelman, Hanson, Hiatt, Fager and Bilyeu (2005) using questionnaires explored the ways in which teachers and other team members learned about, engage in, and acquired skills related to AAC which used more complex technology (p.187). This study gives insight into considerations about how to approach training which involves the use of higher levels of technology. This is critical in the ability of the teacher to engage in AAC, and is assumed by this study to play a strong role in how we design our educational and training practices.

There are a number of common features in the ways teachers view education and training as well as what they describe as valuable to their practice. Anderson (2011) as well as Robinson and Sadao (2005), will be used as examples to highlight some of the understandings found in this research. One of the critical elements found in one of the questionnaires conducted by Anderson (2011) was that, “Most teachers felt that previous learning had not helped them or was of limited use in their current work” (p.13).

However, there was value placed on training and education which could be immediately applied or linked to classroom practices (Anderson, 2011; Robinson & Sadao, 2005).

Robinson and Sadao (2011) expanded upon this more and provided specific features which were valued by teachers. Ongoing Interactions with adults who use AAC and family members who have a child who uses AAC as part of pre and inservice educational programs was of great importance (p.156). These interactions facilitated a change in

attitude and focus on team collaboration, sensitivity to families and the need for supports within an inclusive environment (p.157). Changes in attitudes and openness to AAC was found in the study completed by Patel and Khamis-Dakwar (2005) as well, who noted that, “All of the teachers also indicated a change in their perceptions of what a child with expressive impairments could achieve if given the appropriate intervention” (p.212).

These studies under the category of education and training have put forth a set of understandings which inform the field in the area of policy and practice. They establish the need and value in addressing changes in teacher attitudes and perceptions, the development of knowledge and skills, and greater understanding of the needs of people who use AAC and their families. This can be accomplished through the training in specialized techniques or as part of a broader teacher pre and inservice education program. Strong and explicit links to parallel practice when learning AAC is a critical feature along with consistent access and engagement with adults who use AAC and families who have a child who uses AAC. These components of practice inform the types of policies that districts, schools and institutions of higher education should consider when designing education and training programs.

Chapter 3

Research Design

This chapter describes the mixed methods design used to address the complexities of researching language and communication development for students with multiple disabilities and complex communication needs. In particular, it focuses on the relationship of the LAMP method and display system to vocabulary and communication development as well as interventionist's perceptions. Specifics related to both the quantitative and qualitative structures are presented along with data collection procedures used, human subject protections applied and discussion of the implementation fidelity. Full descriptions of student and adult participants are reviewed to convey the complexities of both the student population supported and the unique qualifications of the adult participants and the collaboration and training needed for AAC implementation efficacy. Additional student protections were implemented to address specific ethical and privacy challenges associated with automated data logging systems.

Mixed methods research (MMR) was chosen as the best match to comprehensively address each research question and sub question which requires the systematic gathering of both quantitative and qualitative data throughout the study. According to Tsushima (2015), "...MM research approaches seem highly useful for conducting research on the influential factors and efficacy of a new assessment practice/format...Through a holistic approach, this methodology has the potential to provide more credible findings than does a monolithic methodology when the data are appropriately integrated" (p.115). The integration of this data capitalized on each individual student and his/her learning as well as capturing the unique perspectives and

context associated with communication and vocabulary development. In addition, Dowding (2013) discusses the importance of mixed methods in creating new knowledge. “Alongside more quantitative approaches to research that produce measurable evidence...qualitative approaches can provide insights into the context and meaning of experiences and provide possible explanations for the relationships between variables measured using more quantitative approaches” (Dowding, 2013, p.542).

The study employed a single-case multiple staggered baseline design with randomized intervention implementation and intervention schedule using the What Works Clearinghouse (WWC) standards from 2010 which required a minimum of five participants. Single-case subject research can assist in identifying what works, who it tends to work for, and under what conditions. It is a method which allows the researcher to look at specific behaviors of students as they may relate to an intervention. Each student becomes his/her own control in this format. This allowed for a much more in-depth explanation of the findings (Kazdin, 2011; Kennedy, 2004).

According to Kratochwill, T., Hitchcock, J., Horner, R., Levin, J., Odom, S., Rindskopf, D. and Shadish, W. (2012), to meet the WWC standards, “a multiple-baseline design must include a minimum of six phases with at least five data points per phase” (p.29). This study employed an ABB-ABB-ABB-A style randomized intervention design for each student (refer to *Table 1*). Randomization assists in eliminating pre-treatment bias which may be reflected in results. A minimum of three cycles was completed for each of the five students using of the ABB-ABB-ABB-A randomized pattern. A represented the baseline performance phase and B was the intervention. Once the first baseline was considered stable the first intervention cycle began for each student. Each

cycle established a baseline using a minimum of five data points and the same language sampling process followed by six randomized intervention phases. Using the multiple baseline method required a staggered application of the intervention. All students began in the baseline phase. Baseline for each student included a minimum of five language samples which occurred during a fifteen-minute 1:1 literacy session using a familiar text at the student's current instructional reading level (baseline for word only vocabulary was not been included for the first baseline but is included for each baseline following an intervention phase). Each of the identified participants used only icon with word vocabulary presentation.

Table 1

Randomization & Staggered Intervention Implementation

Student	Randomized Intervention Sequence	Date of First Intervention
Holly	A-BB-AA-BBBB-A	April 27 th , 2016
Cameron	A-BBB-AA-BBB-A	May 2 nd , 2016
Sam	A-B-A-BB-A-BBB-A	April 13 th , 2016
Brenden	A-BB-AA-BBB-A-B	April 7 th , 2016
Ruth	A-BBB-A-BBB-AA	April 27 th , 2016

Note: A= Baseline phase; B= Intervention Phase

As part of the mixed-method approach, semi-structured interviews were conducted at the end of the study examining the perspectives and experiences of the adult participants on the LAMP method, student impact and collaboration in the study on an individual basis. Semi-structured interviews tend to use more open-ended questions

where there can be elaboration by the participant in a dynamic and reflective manner. In addition, consideration of interviewing format was based on Farber's (2006) discussion on qualitative research for school counselors. According to Farber (2006), "it is important to establish rapport, set the tone, discuss confidentiality, discuss your purpose, and address any concerns/questions your interviewee may have" (7). Rapport was established throughout the research study. Adult participants worked closely with the researcher and had regular check-in opportunities to discuss the study as it was conducted. The purpose of the study was fully reviewed prior to commitment to voluntary participation. Concerns and questions were brought up and addressed throughout the entire study. During the interview process all points outlined by Farber (2006) were reviewed before the interview began. There was no set timeframe on the duration of the interview. It remained flexible to meet the needs of the study as well as giving the interviewee ample time to elaborate without arbitrary constraints.

Setting

A public Collaborative south of Boston, MA was selected for the research site. A collaborative is made up of a series of member towns to serve as an extension of the public school. The school is in an affluent community but serves students across fifteen towns and cities both urban and suburban composed of varied socioeconomic and cultural backgrounds. Students from communities outside of the organizing towns may attend school programs at a collaborative as well. The school program participating in the research study serves students with severe and multiple disabilities. These students often present with complex communication needs which require additional supports including augmentative and alternative communication. The school serves approximately 115

students ages 2.9 to 21 years. This is a day school with an extended school year program including 30 minutes of additional instruction each day, as well as a seven-week summer program. Students may attend a full day or partial days depending on their individual needs.

The school program offers extensive therapies which include but are not limited to; speech and language, direct assistive technology services, physical therapy, occupational therapy, vision services, orientation and mobility services, behavioral therapy, music therapy and adapted physical education. These services are provided in a transdisciplinary fashion which is a key characteristic in understanding how the LAMP method and display system will be implemented on a daily basis. Consistency and carry-over directly impact all aspects of learning and achievement.

Inclusion/Exclusion Criteria

Each student participant had consistent school attendance throughout the study. Each student participant was already using a SGD with the LAMP method and display. Student participants had to be between the ages of three and twenty-one. Guardians were required to give full approval for the study, as well as assent given by each student with information provided in accessible language.

Adult participants had worked at the school for a minimum of one year. A one-year minimum was required to ensure fidelity of implementation through proper training and experience with SGDs as well as introduction to the LAMP method and display system. All adult participants had additional trainings on LAMP as well as the research procedures. This involve a minimum of two sixty-minute (approximate) training sessions including;

Training Session 1:

- Overview of the study and the two primary research questions.
- Overview of LAMP
- Participant expectations
- Researcher expectations for role and support throughout the study
- Timelines
- Questions and answers

Training Session 2:

- Baseline procedures
- Intervention procedures
- Practice sessions modeling the intervention with other adult participants
- Data Collection
- Questions and answers

Participation was voluntary but commitments were required for the full research study unless unforeseen circumstances arose. Each adult participant was interviewed by the researcher to determine qualifications for the study and willingness to commit. Once an adult participant committed to the study, a research agreement between the researcher and the adult participant was signed. Adult participants included paraprofessionals, teachers and speech and language pathologists. Three speech and language pathologists assisted in the inter-rater reliability portion of the study to address implementation fidelity. The speech and language pathologists were interviewed to determine their experience with the LAMP method. A minimum of one year of experience was required to participate in the study.

Student Participants

Five students were selected for this study (refer to *Table 2*). All students attended the same specialized separate public collaborative school for students with complex educational needs who require augmentative and alternative communication. All students in the study were non-speaking and required extensive AAC supports to engage in all aspects of their lives. Each student chosen for the study currently used or had successfully completed a trial for an advanced speech generating device (SGD) that used the LAMP method. Four of the students made direct selections through pointing using an isolated finger. One student required the use of a keyguard which provides tactual guidance for improved accuracy in icon selection. One student made direct selections through the use of eye-gaze technology.

Table 2

Student Participant Characteristics

Student	Age	Grade	Gender	Ethnicity	Current Device	Selection Method	Current experience with LAMP
Holly	9	3	Female	Black	Accent 1400 with NuEye tacking system	Eye-gaze	2 months
Cameron	10	4	Male	Caucasian	Vantage Lite	Point with isolated finger	5 years
Sam	11	5	Male	Caucasian	Accent 800	Point with isolated finger with keyguard	4 years
<i>Brenden</i>	12	6	Male	Caucasian	ACCENT 800	Point with isolated finger	5 years
<i>Ruth</i>	14	9	Female	Caucasian	Accent 1200	Point with isolated finger	1 year

Holly is a nine-year-old girl who is diagnosed with Cerebral Palsy. She communicates through a total communication approach using facial expressions, vocalizations, eye-gaze shift towards desired objects, body movements and her advanced eye-gaze communication device (Accent 1400 with NuEye). She enjoys art, circle time

and journaling. Holly is very social and consistently demonstrates empathy for the other students in the class. She uses a wheelchair as her primary seating and mobility system. Literacy based goals address the identification of printed letters associated with demonstrated isolated sounds. In addition, she journals every day through choice making, identifying which activities she completed and would like to communicate about to her family when she arrives home. These literacy activities can be completed using her device as well as through a low tech partner assisted scanning system and a mid tech voice output switch which states, “that’s the one I want”, for when her device may not be available. Holly is new to the Accent 1400 with NuEye and had been trialed originally for a Tobii C-12 speech generating device. The Accent 1400 with NuEye was determined to be the better fit for her communication needs along with the Unity Symbol set which uses the LAMP method.

Cameron is a ten-year-old boy who is diagnosed with Rubinstein Taybi Syndrome. Cameron enjoys socializing with his peers and engaging with books. He uses a total communication approach which includes a combination of spoken language, ASL and his Vantage Lite to communicate. He is ambulatory and very independent in his movements within familiar environments. Based on the Accessible Literacy Learning (ALL) program and is in late phase two of building conventional literacy skills. Cameron is able to identify all letters and letter/sound correspondences with 100% accuracy and is able to identify grade 3 sight words using a directed point with 80% accuracy from a visual field of up to 9. Cameron can identify initial, medial and final consonant sounds within cvc (consonant-vowel-consonant) words using his Vantage Lite and he is working on blending sounds as well as segmenting words, using letter symbols on a Veltex board

and/or his Vantage Lite. He demonstrates the ability to decode CVC words by accurately selecting the corresponding picture symbol from a visual field of 4 or by locating the corresponding symbol within his page set on his Vantage Lite with 90% accuracy.

Cameron enjoys participating in shared reading tasks, which provide an opportunity for him to apply decoding skills during actual book reading activities. During this type of task, the instructor reads each sentence and pauses at simple regular words for Cameron to decode. Cameron is subsequently asked to decode the word and then select the appropriate picture symbol or locate the word in his Vantage Lite. Cameron uses the LAMP Words for Life software program.

Sam is a ten-year-old boy who is diagnosed with Cerebral Palsy. Sam enjoys swimming, bowling, baseball, humor, music and pretend play. He uses a total communication approach which includes, ASL, vocalizations, ECOpoint communication device, Accent 800 communication device, low tech communication boards, facial expressions and gestures. He is currently reading at an instructional level D (Reading AZ). He has demonstrated great improvement using his ECOpoint communication device showing independent 'trial and error' sentence production, self -advocating, independently stating needs and health concerns and retaining new vocabulary placement. Using the guided reading measures and benchmarks, Sam is reading and comprehending at an instructional guided reading Level C and his listening comprehension is an instructional Level F. Spelling skills indicate that he is in the consonant and short vowels stages. Sam utilizes a wheelchair as his primary mobility and positioning support. It is important to note that Sam is in the process of trialing an Accent 800 with direct section using an isolated finger point.

Brenden is a twelve-year-old boy who has been diagnosed with Aperts Syndrome. He enjoys swimming, using the iPad, listening to music, socializing with friends and humor. He uses a total communication approach using word approximations, gestures, body positioning, signs, facial expressions and the Accent 800 communication device. It is important to note that the Accent 800 is a newly implemented device beginning in July 2015. Prior to this he used a Vantage Lite in which he was able to navigate through multiple levels generating utterances of up to five words in length, given varying levels of prompting. Receptively, Brenden demonstrates an understanding of functional concepts within the school environment and follows directions, given cues. He appropriately answers yes/no questions, as well as various wh questions within context. Brenden is a social young man who enjoys interacting with communication partners who are familiar and with whom he is comfortable with. Both devices use the LAMP method and it is anticipated that he will make a smooth transition to this device.

Ruth is a 14-year-old young woman who is diagnosed with spastic quadriplegia. She has a vision loss as well as a bilateral sensori-neural hearing loss and is considered deafblind. Ruth enjoys her cat, specific television shows, completing her work at school and socializing with friends. Ruth uses a total communication approach which includes; ASL, pictures, gestures, facial expressions, vocalizations, word approximations and her Accent 1200 communication device. Ruth is currently able to read and comprehend early grade 1 text. Ruth received a new communication device in the Fall of 2014 (Accent 1200). This device continues to use the Unity symbols and LAMP method. A language sample found her spontaneous mean length of utterance to be 4.0 words with her Accent 1200 communication device. Ruth is able to produce longer utterances with brief verbal

reminders to use full sentences with appropriate syntax and morphology. She is exceptionally fluent expressing sentences with her Accent 1200 communication device, particularly for commonly discussed topics (eg: dinner, television shows, baby brother and Lucas the cat). Receptively, Ruth responds appropriately to two step directions, yes/no and WH questions, and most informal conversation around her. She has a strong visual memory and can easily recall symbols, their locations for message retrieval, and is able to coordinate motor activities with the use of her device. Ruth has a fairly broad expressive language vocabulary especially at the single word level. She labels nouns (people, animals, school things, toys, foods, clothes, shapes); describes using single adjectives (colors, opposites, feelings); states location using single prepositions (in, out, outside, up, down); names actions (play, jump, eat, watch); and uses gender appropriate pronouns (she, he, they). Emerging are concepts of plurals with –s ending, possessive pronouns ‘hers, his, mine’ and possessive noun forms (John’s, Gina’s), verbs with –ing ending (painting, washing, drawing); and regular past tense verbs.

Adult Participants

Five adult participants functioned as individual student interventionists. This included two teachers and three paraprofessionals. All adult participants already had regular contact with each student as a part of their normal work responsibilities. Teachers and paraprofessionals were from the same classroom as each student participant. The three speech and language pathologists (SLPs) functioned as inter-raters as part of the treatment fidelity process. Each were familiar with the student participant they were assigned. All adult participants had at least one year of prior experience supporting

students who use advanced SGDs. Experience ranged from one year to 25 years. *Table 3* summarizes the adult participant roles, years of experiences and student assignment.

Table 3

Interventionist Characteristics and Student Participant Assignment

Interventionist or Speech & Language Pathologist (SLP)	Role	Years Experience	Brenden	Sam	Holly	Cameron	Ruth
Interventionist 1	Paraprofessional	1			X		
Interventionist 2	Teacher	13				X	
Interventionist 3	Paraprofessional	1	X	X			
Interventionist 4	Teacher	3					X
Interventionist 5	Paraprofessional	2					X
SLP 1	Inter-rater	25			X	X	
SLP 2	Inter-rater	7	X	X			
SLP3	Inter-rater	10					X

Ethics Approval

The Boston College Institutional Review Board application was completed and full approval received. In addition, full approval was acquired based on authorized research practice policies at the South Shore Educational Collaborative. Additional safe guards proposed by Higginbotham and Golinker (2008) when using automated data logging (ADL) software were also applied. To ensure appropriate access controls the following was addressed:

- All data collected through ADL was specifically identified and included on parent/guardian permission forms.
- Only the researcher, the participant's speech and language pathologist and the parents were authorized to review the data.
- Parents had the ability to agree or disagree with the storage of data option.

- Parents were notified of the findings of the current research as well as any potential future publications from this study.

Data Collection Procedures

Specific qualitative and quantitative data were collected to address each primary research question and sub questions. Quantitative data collection included;

- Vocabulary (icon with printed word present) selection: measured by the actual physical selection of the icon by the student (total number during a fifteen-minute session).
- Communication functions (pre and post intervention) as measured by the Functional Communication Profile Revised.
- Prompting level: using the prompting level data recording form, interventionists recorded the word and prompt level used during the fifteen-minute 1:1 literacy session.
- Utterances: Number of utterances per session (elicited by interventionist and initiated by student) and length of each utterance occurring during the fifteen-minute 1:1 literacy session.

Automated data collection and logging systems were used to collect and analyze the vocabulary and utterances. Specifically, the Language Activity Monitor (LAM) (<https://www.prentrom.com/support/article/315>) which was already loaded on all individual student devices was programmed to take data on the identified variables at a specific time for a specific duration. These data were then downloaded to the Realize Language (<https://realizelanguage.com/info/professionals>) online software program for full analysis.

Using automated data logging (ADL) addressed the potential for errors and inconsistencies in data recording and provided for a uniform method of data collection for three of the eight identified variables measured (listed below). Cross (2013) notes that there are limitations of such data recording which require careful notation for this study. These include such things as notation of input by a communication partner, other modalities of communication used at the same time, modeling of linguistic functions and selections as well as the environmental context in which the linguistic behavior has been recorded (p.1). Additional data was taken by interventionists who recorded these portions of the data to address the limitations of the ADL system. ADL alone is insufficient to adequately capture the communication and linguistic abilities of a student. Data collection on identified indicators occurred six times per intervention phase. Intervention intervals were randomized. A five-point minimum was required based on the current WWC standards. Intervention implementation was recorded during individual literacy sessions using a familiar text at the student's current instructional level. Literacy lessons were conducted in a quiet setting. Each of the six intervention sessions included the following data sources during the individual 1:1 fifteen-minute literacy session. These data sources were an expansion on those identified for baseline collection. The addition of the word only data source is significant here. As mentioned previously, all participants began with symbol/word combinations. During intervention, the symbols were gradually removed based on high frequency usage leaving only the printed word.

- Vocabulary selections (icon and printed word present) (ADL)
- Vocabulary selections (word only) (ADL)

- Utterances: ADL was used to record the actual utterances while the SALT research software analyzed the number and stage of the utterances for each fifteen-minute 1:1 literacy session.
- Communication functions (pre and post completed intervention) as measured by the Functional Communication Profile.
- Prompting level: using the prompting level data recording form, interventionists recorded the word and prompt level used during the fifteen-minute 1:1 literacy session.
- Input by communication partners (if any): Recorded by the interventionist on provided data collection form.

The study used a minimum of fifty data points per student participant which included both baseline phases and intervention phases. The study included a three-four-week follow-up for skill maintenance. The variation in follow-up was due to the break between the end of the school year, the start of the extended school year and student personal vacations or time out of school. Pre and post assessment data was gathered using the Functional Communication Profile (FCP-R) and the language activity monitor (LAM) as discussed earlier with data analysis initially completed using the Realize Language online software both designed by the Prentke Romich Company (PRC). Post assessment included an analysis of the formative data collection which has occurred over the entire study as well as an analysis using the SALT research software which is based on normal language development. This particular software program was used as a source of comparison to typical language development and is an established research software

program which is compatible with SPSS®, SAS®, Excel® and Access® (<http://saltdev.chrenwerks.com/products/for-researchers>).

To address Wolery's (2013) critique of the WWC Standards (2010) regarding, "...evaluating effects of instructional interventions on the acquisition, maintenance, and generalization of new adaptive behaviors..." (p.41), the print word mini post assessment was conducted four weeks after the final baseline phase had been documented. This looked at concept maintenance after the intervention sessions had been ended. To address generalization of print concepts within the classroom environment, the print words measured were introduced within typical literacy lessons. Data was taken three to four weeks out for a minimum of five sessions looking specifically at the use of these words within the 1:1 literacy session.

Qualitative data collection was used to explore the in-depth relationships between vocabulary and utterances as well as to address implementation fidelity. Directed content analysis was used to expand upon current theory and practice. The data collection form used by each interventionist was used to break information down into both predetermined categories as well as categories which emerged as a result of the analysis. These predetermined categories were based on the data collection plan. According to Zhang and Wildemuth (2005) "Qualitative content analysis goes beyond merely counting words or extracting objective content from texts to examine meanings, themes and patterns that may be manifest or latent in a particular text. It allows researchers to understand social reality in a subjective but scientific manner" (p.1). The data collection form had the following sections to support the content analysis;

- Communication

- Vocabulary
- Responses
- Interaction
- Context
- Nonverbal communication
- Other

A final interview was conducted with each interventionist using predetermined open ended questions along with an opportunity to add other relevant information as identified by the interventionist. The initial questions addressed the three primary research questions to begin the discussion. Communication and language development were defined prior to the participant answering either question. Several predetermined sub questions were provided with opportunities for each participant to expand on questions and offer additional information which was not directly or indirectly probed. Below are the questions used to frame the interview process. It is important to note that the questions were shaped by the study. DiCicco-Bloom and Crabtree (2006), The basic research question may well serve as the first interview question, but between 5 and 10 more specific questions are usually developed to delve more deeply into different aspects of the research issue” (p.316).

- Please tell me overall your impressions of the study. Think about this in terms of student impact and then in terms of the impact on you.
- Given this definition of communication (Communication is the sharing of information across a variety of modalities), tell me how you think the LAMP method and intervention impacted the student’s communication?

- Can you tell me more about the student's use of communication functions keeping this definition in mind; Gail Van Tatenhove (2007) discusses communication function as relational functions. That is, communication functions are those acts which have a pragmatic component such as but not limited to; directives, requests, associatives, naming and greeting (p. 4). The variety and complexity of communication functions can range from a single word to complex sentences.
- How did LAMP and this intervention impact communication at other times during the day or in other settings?
- Given this definition of vocabulary (vocabulary is commonly taken to mean a set of words or phrases), tell me how you think the LAMP method and intervention impacted the student's vocabulary?
- If you had to convey three important takeaways from this study, what would they be?
- How did your previous training and experience as well as the training provided for the intervention impact your implementation and participation in the study?
- What role does collaboration play in all of this?

Procedural Fidelity

Procedural fidelity and treatment integrity were addressed through the close monitoring of staff training and implementation as well as through the automated data logging in place. Ledford and Wolery (2013) suggests two critical components which must be measured and monitored to ensure procedural fidelity. They identify, "... whether researchers implement training procedures correctly and whether indigenous implementers can (and do) implement interventions successfully after training" (p. 174).

One intervention session per phase was videotaped. During this process intervention fidelity was assessed by two raters. One rater was the researcher whereas the second rater was one of the three speech and language pathologists. As stated previously, raters were licensed speech and language pathologists. As licensed speech and language pathologists, they have the expertise needed to evaluate both the language and communication components observed in the video.

Videotaping occurred during the intervention and baseline phases for a total of four video recordings per student. A data sheet was used by the researcher and SLP to record data from the videos to calibrate what data should have been recorded by the interventionist. This calibration process between the researcher and the SLP was critical in determining the consistency in which prompting and qualitative notes were being recorded. Variations in the implementation of the program were addressed immediately through retraining and follow-up consultation with the interventionist. The inter-rater reliability score was determined by comparing the level of agreement between the data sheet recorded by the interventionist and the calibrated data sheet from the researcher and SLP.

Analytic Plan

A comparative analysis was conducted on vocabulary acquisition (icon & print only), prompting levels, communication functions and utterances. A comparative analysis was chosen due to the nature of the variables measured by this study and assisted in identifying relationships between observed variables which may be both dependent and independent. Baseline phases were analyzed attending to the following measures looking more specifically at the between-phase data patterns. These measures

included; (1) variance, (2) data patterns (immediacy of effect), (3) trend, (4) mean length of utterance, and (5) consistency of data patterns.

Staff were debriefed after the final week of the study by participating in a semi-structured interview. Content analysis of the data was used to link and contextualize the implementation process, the data collected and the perceptions of those involved. Qualitative information from the interviews was organized and coded into predetermined categories and post study categories which emerged from the analysis (Hsieh and Shannon, 2005, p.1282). Directed content analysis draws from current theory and findings of the study. As suggested by Hsieh and Shannon (2005), "...open ended interview questions can be used followed by targeted questions about the predetermined categories" (p.1281). The communication partners play a significant role in all aspects of language development. Analysis of specific perceptions placed the quantitative data within the context of the communication dyad. This was critical in understanding how the LAMP method impacted language acquisition and communication.

Qualitative analysis of content used the guidelines discussed by Zhang and Wildemuth (2005). The data from the interview was transcribed literally and included all questions asked. The unit of analysis was defined by both the predetermined categories and additional categories which emerged from the data. The coding scheme as mentioned earlier was developed through a deductive approach using current theory and research results. The coding scheme was first tested on a sample transcript. This was followed by an assessment of inter-coder agreement as identified by Zhang and Wildemuth (2005, p.4). Once inter-coder agreement had been established, coding began. Inter-coder agreement was checked for a portion of the coding in each interview to ensure

consistency and reliability. Conclusions and findings are based on the coded and analyzed data and integrated into the analysis of all research data. Predetermined categories included the following based on the literature review, research questions and data collection;

Table 4

Category definitions and coding rules

CATEGORY	DEFINITION	CODING RULE
COMMUNICATION	Student conveying messages, comments and responses using their SGD, vocalizations, gestures or facial expressions. Sharing of information across a variety of modalities.	Comments must include any of the following; how, why, what and quality of communication made by the student directly. Comments may include communication during the 1:1 literacy sessions as well as during other times in the day.
COMMUNICATION FUNCTIONS	The purpose of the student's communication as identified by the interventionist. Examples; gain attention, make a request, commenting, greeting, directives.	Comments identify communication made by the student during and outside of the 1:1 literacy sessions which specifically notate the purpose of the student's communication.
VOCABULARY	A set of words or phrases used by the student. Includes all modalities as defined in the communication category.	Direct mention of vocabulary used by the student. This may include expansion, variation in use, word combinations and changes in word format (example: tenses, possession, contractions)
LAMP	Method which includes: <ul style="list-style-type: none"> • Readiness to Learn • Shared Engagement • Auditory Signals • Natural Consequences 	Direct mention and comment on the components of the LAMP method.

CATEGORY	DEFINITION	CODING RULE
	<ul style="list-style-type: none"> Consistent Motor Patterns 	
SOCIAL VALIDITY	The way in which the adult and student participants responded to the LAMP method that was identified as meaningful or having value to the student and/or the adult participant.	Comments identify adult participant feelings towards the LAMP method, concerns, identified relevance of student and adult outcomes or potential future impact.
INTERACTIONS	Adult and student shared engagement and shared actions during and outside of the 1:1 literacy sessions.	Specific interactions identified by adult participants as examples relevant to their feedback on the study.
TRAINING	Training provided prior to the implementation of the study and additional input received during the study by the researcher, SLP and other interventionists.	Comments identifying the impact of and need for training as well as any additional feedback and support received during the study.

The information provided within the question of other and the three takeaways from the study were coded and integrated into the identified categories.

Limitations

There are methodological limitations associated with single case study multiple baseline approaches. It was reasonable to anticipate some inter-dependency between the unique characteristics of each environment, communication partner and student (Kazdin, 2011). The role this played in the identified baseline was not immediately distinguishable. That being said, the qualitative data collected during the study assisted in placing these potentially inter-dependent variables in context.

Setting and student limitations did impact the continuous implementation of the intervention week to week. There will be known lapses in the intervention study due to

predetermined school breaks. These lapses in intervention were a part of the known challenges in maintaining skill acquisition for students with more complex disabilities. One student's absence (Cameron) did interfere in the generalization phase only. No other substantial interruptions occurred. All students experienced some absences. These absences did not impact data collection. These limitations were viewed as a natural component of supporting students with more complex disabilities. In addition, student errors were difficult to identify. An answer may be wrong but deliberate in selection or may be correct but accidentally chosen (by mistake or guess work). The results of the study were placed in this context and viewed as the day to day realities which must be considered when evaluating any intervention. This was resolved through discussion with the interventionists to clarify the data recording.

CHAPTER 4

RESULTS AND DISCUSSION

The purpose of the study was to examine the impact the Language Acquisition Through Motor Planning (LAMP) method had on language and communication as well as looking at the perceptions of the interventionists. The study used mixed methods to target the removal of picture based symbols, replacing these specific picture symbols with print words only. Words were chosen based on frequency of use during the baseline data phases throughout the study. Consideration was also given to the selection of core words. These words are used most often in daily communication and within written texts (Halloran and Halloran, 2006). All students were able to choose a familiar text to engage with throughout the study. Only texts that were previously selected by students were offered as selection to choose in the generalization phase. Three teachers, three paraprofessionals and three speech and language pathologists participated in the study. The five student participants were from three different classrooms; with Holly and Cameron from one classroom, Sam and Brenden from the second classroom, and Ruth from a third classroom in a different building. All student and adult participants had some experience and exposure to the LAMP method prior to this study and some additional training. Each student and adult participant participated in the full study with no interruptions besides those that naturally occurred during the school year. Naturally occurring disruptions included the school April break from April 18th through April 22nd, Memorial Day on May 30th and the break between the end of the school year and the start of the extended school year, June 17th through July 4th.

Data for each student was collected weekly using the automated language activity monitor (LAM) on each student's device as well as on a data recording sheet which provided information on prompting and student responses not recorded by the LAM such as student specific behavioral responses. Data was collected during the 1:1 fifteen-minute literacy sessions that occurred several days per week one-two times per day. Interviews were conducted at the end of the final phase of the study (before the generalization phases) and have been organized into categories to provide a more in-depth look at the perceptions of the five interventionists.

Results are first presented individually followed by a broader discussion of themes. Each set of individual results looks at the impact on language followed by the impact on communication. Students are presented by classroom with Brenden and Sam in one room, Holly and Cameron in the second room and Ruth in another as well as being in a separate building. Overall there were variations in progress across student participants with some demonstrating more consistent gains. All students sustained gains during the generalization period that occurred three-four weeks after the final data collection cycle. All generalization data was collected from early July through early August.

The results discussion begins with the interview data looking specifically at the perceptions of the interventionists. Pertinent comments on individual student participants are noted within individual results. A total of five interventionists were interviewed. Results are organized based on the predetermined categories.

Summary of Interventionist Perceptions

Five interventionists were interviewed at the end of the study to explore their perceptions and to look at additional information that which could clarify or provide

context to some of the student data. Interviews lasted from eight to fifteen minutes. Each interventionist was given opportunity to expand on their answers and to elaborate at the end if they felt something had been missed by any of the questions. The interviews were semi-structured using questions related to the research questions in a more open-ended manner. Interviews were audiotaped only in a private area of the school. Audiotapes were transcribed by the researcher and then placed in predetermined categories where they were used to begin the analysis. Predetermined categories included (refer to *Table 4* for definitions and coding);

1. Communication
2. Language
3. Communication Functions
4. LAMP
5. Social Validity
6. Interactions
7. Training

A deductive content analysis was used to categorize responses across these predetermined categories and their definitions. Communication and communication functions were integrated by the interventionist during the interviews and will be integrated here as well. Therefore, for the purposes of this discussion they will be combined into one category. In addition, social validity showed many overlapping comments that focused specifically on communication. Social validity will be discussed as a subcategory of communication. One additional category of “collaboration” was added based on the themes from the interviews. Collaboration was noted by the interventionists when discussing training needs and will be included within the training category. It is defined as, working with other members of the study to find common

ground on implementation. The coding rule includes; any comment made by an adult participant identifying collaboration with others outside of the initial training provided by the researcher and not including input received from the inter-rater agreement process.

Impact on Communication including Social Validity

Each of the interventionists talked about improvements in self-advocacy. Each cited improvement in the way the student asked for help appropriately and felt that these skills carried over into other aspects of the day. Students used their SGSs throughout the day and often combined the device use with sign language and vocalizations to reinforce the request or need for assistance. Each student also had opportunities to learn how to find words in their devices by using the ICON Tutor as noted specifically by two of the interventionists. This speaks to the self-determination & advocacy skills noted in the communication impact sections for each individual participant. The interventionists commented in skills related to self-determination.

In morning news she does her own news using her Accent and she's added in words ah um like about through direct instruction in the room she has started adding those in as well into in her answering questions. (student participating in adding words to her device now).

A second interventionists commented on the spontaneity of the student's response.

She has done a lot with that and doing it more spontaneously (more complex sentences).

A third interventionist focused on the level of independence in communication skills.

She knows how to get from board to board independently.

Social validity can be seen as a theme throughout the study findings. All student participants were noted as making significant gains in their ability to use their DGDs across environments, began to program or assist in programming new words as well as learning how to find words that have not been located previously. This was also seen in each participant's consistent ability to ask for help for a variety of reasons. Brenden's interventionists commented, "So I thought it was really cool and um to see him ask for help when he didn't know where something was or even just from his memory once you the first time you took the picture away". Increased vocalizations were noted specifically in one student by the interventionist. Increased vocalizations using the LAMP method were also seen in one participant in the study conducted by Potts and Satterfield (2013).

Impact on Language

All of the interventionists described changes in students' vocabulary use in particular. Three interventionists discussed the purposeful use of the vocabulary students began with noting mild expansion where as two others saw a significant difference in the student's growth. One interventionist said the following regarding Ruth,

Ah, over the course since December until now she's learned sixty-seven new words through the Dolce and her goal was to do 100 by next December so at this rate she will definitely meet at the next and then exceed and the dolce sight her Accent with the Unity symbols had 200 of the 250 something words of the 4th grade Dolce sight word list. So we eliminated the ones that weren't in there to start with and we are just working on those.

Sennott, Light & McNaughton (2016) point out the importance in how word parts are made available to AAC users to assist in the formation of unique individualized

utterances. This type of flexibility was noted by each interventionist through comments on word usage and expansion, as noted in the sample quotes. One interventionist pointed out the increased purposefulness she saw in how vocabulary was used or selected in the case of Brenden. The interventionist commented;

Most of the time he just tries to get to the point or whatever word like hungry...bathroom this that or the other thing... but his vocab is more on point rather than he would just stim and or um obsess over certain words.

LAMP

All of the interventionists felt that the LAMP method, specifically the motor memory portion had a sustainable impact on the students, which allowed them to expand or refine their vocabulary, retain it and use it across settings.

Interventionists mentioned the following when discussing LAMP;

I feel like at the beginning I feel like I was ah skeptical....as how is this going to work seemed kind of difficult. Now I sit down with my students and within seconds bing bang boom...I already know what I want she is full of so much information.

A second interventionist when on to comment about the motor memory and the generalization of skills across settings.

....that it ended up being very effective for students who especially who use muscle memory to find and um use new vocabulary. ...that it ended up generalizing across multiple settings within the school and they didn't just oh I use this just now and especially with the student she really took it and went with it and adding to the complexity to the way she does her sentences.

A third interventionist found value in learning more about the language system and how it promoted more complex language.

Cause they are so similar so and because I learned the student and the way not every picture represents one thing it represents multiple things which gets you into a topic board I really like the way that is designed for kids who can manage something along those lines. and not keep them at this word and this word means it so isolating otherwise and it works well with kids who can do the smaller core boards because...

One interesting observation made by one interventionists involved the motor planning using the LAMP method. The interventionist noted;

The fact that a lot of the symbols are all in the same spot is what really helped and because over time she is learning the muscle memory of going to the same spot but just because you took away the picture doesn't mean she remembers exactly where that same picture is.

This was part of the motor memory that is intended to be built into the LAMP method. Learning the motor pattern first and then the word meaning is intended to assist in vocabulary development over time. The comment is well taken in terms of learning the print versus the picture icon. One possible reason for progress using the print words may be directly related to motor memory versus recognition of the print. The print may initially be irrelevant whereas the motor memory is the more powerful piece in using the word. One interventionist expressed a concern regarding the system and the amount of effort it can take to access all of the boards on a more advanced level. The interventionist noted that, "If you got a kid who could cognitively do it but then physically couldn't

touch past a board that was like 15 by like a 15-square board then there is a lot of button pushing to get into some more complex things”.

Regardless of access method, most advanced SGD systems that which have large resources of vocabulary require navigational skills which increase physical and cognitive demand. The LAMP method attempts to reduce this through consistent motor patterns that may reduce both the cognitive and physical load for the student (Halloran & Halloran, 2006; Potts & Satterfield, 2013). This interventionist brings up a consistent challenge in the field that must be considered and assessed in our ongoing pursuit of the most efficient and effective language system for students with more complex disabilities.

Training & Collaboration

Participants spoke extensively about the need for training and ongoing support. They consistently commented on the complexity of the system and that the research study helped them learn the device and the system itself better. Many of the adult participants found additional materials to read on LAMP, consulted with others and took additional time to learn the system. This was not an expectation of the study but rather an example of the vested interest the interventionists had in the student communication systems. It is also important to note that two of the interventionists were classroom teachers and three were classroom paraprofessionals. Lorah (2016) compared teacher and student preference across two methods of AAC. One of the important findings was the high degree of implementation fidelity presented by the teachers. Several of the interventionists commented on their pre-study training and how consistent implementation was maintained;

It is really funny because I personally knew nothing about this device when I first started. So I had to do a lot of studying before we first started this project. So I had to do a lot of studying before we first started this project.

A second interventionist cited her current work experience as being key.

Starting here I learned a lot because I had never worked with an Accent using Unity software so I have had a lot of time now that I have been here to really learn the way the Unity software works and ...just doing with another student she uses a similar (SGD) it's not the exact same as Unity but um the way her software goes too it's helping me learn how other kids are accessing it as well too.

A third interventionist discussed how they worked with others to insure consistency.

Um we had (SLP) coming in watching and observing and then (other interventionist) and I making sure that we were presenting it the same way even though both of us were doing it at different times. And she watched me do it the first couple of times and then she said alright I've got this and then I watched her do it and then I knew that she could do it so I was comfortable with her being able to do it and then on days when she wasn't here because we both did it the same way in the beginning I could take over do it and the student was fine doing in with doing it with both of us.

There was ongoing effort to ensure consistent implementation. The other important piece that emerged from the interviews was the collaboration mentioned in the previous quote as well as access to the researcher. Collaboration through the transdisciplinary team process has been found to be essential in effective implementation including positive

attitudes towards AAC (Chung & Stoner, 2016; Dada & Alant, 2002; Mukhopadhyay & Nwaogu, 2009; Pufpaff, 2008; Shire & Jones, 2015). One interventionist stated;

Well there was a lot of collaborating... it was good at the beginning. I.. we ironed out a few of the issues that we've had... I think that if I never came to you with any issues like questions or concerns or anything that it would have been a huge fail because I just would have been writing down anything and not really taking accurate data because I would have just been asking questions and showing them how to do it rather than them doing it themselves. If there was no collaboration... I probably wouldn't have done it as consistently if there was no collaboration.

The additional collaboration initiated by the impacted the study and potentially the student results. This also indicates that access to the researcher may have impacted the study. The researcher was available for questions and clarification as well as the speech and language pathologists who engaged in the inter-rater agreement sessions. Regular and ongoing feedback may have improved interventionists' understanding and confidence in the implementation. Shire and Jones (2015) note that, "partner's adoption and accurate implementation of communicative strategies and their impact on children's outcomes may be influenced by a number of factors that need to be addressed for a full understanding of the efficacy of partner training programs" (p.12). The relationship between training and collaboration are relevant to successful outcomes. This study would need to explore interventionists' characteristics in more detail to fully understand the impact this may have had on the benefits of the training and the self-initiated collaboration. Finally, the interventionists overall made statements indicating they perceived the study as successful or beneficial to the students.

Ok, um... I think I was impressed with the progress of the study um... and it was interesting to see what the students were going to do and um for this particular student as far as the impact on me with them I think that it sort of challenge me I saw the cool things he was doing so it challenged me so I can work with him so I can step it up what we are doing a little bit because a lot of the vocab you took away he did not miss a beat when the picture was gone it was just like whatever I spell I can get it I still know exactly what word this is I know how to use it correctly so I think for me that was a signal that he can work on harder things um... as we are progressing with his literacy skills.

A similar statement was made by a second interventionist.

I thought that this was a great study and I was really surprised um I didn't think it was going to turn out this way to be honest I didn't think they were going to be able to um do as well as they did without the pictures and I think that the pictures sometimes are confusing.

Overall the interventionists' comments were consistent with the data collected and analyzed in each individual student participant section that follows this discussion.

Interventionists were sensitive to the need for consistent implementation. Perceptions were initially skeptical of the study, but these reservations did not appear to impact the effort placed into acquiring ongoing information on their own about LAMP, observing each other for consistent implementation, and seeking out consultation and clarification when needed. Each perceived an impact on language and communication, and were able to describe specific examples of each that could be directly correlated with examples from the transcripts of utterances.

These interviews highlight many of the important characteristics discussed in Chapter 2 under Teacher Interactions. We know beliefs, assumptions and training are key factors in the consistent implementation of AAC systems. The interviews touched on each of these, reinforcing research which has occurred over the past decade. These remain important considerations in planning for and supporting a variety of AAC methods, including LAMP.

Individual Student Results: Brenden

Brenden began participation in the study on 4/4/16 with the final phase ending on 6/17/16. Generalization data occurred between 7/18/16 and 7/27/16. Table 5 shows the ten phase cycle including the words targeted for intervention.

Table 5

Brenden's randomized cycle with phase dates and words targeted for intervention (print only) including core words (high frequency) are highlighted in yellow.

CYCLE	PHASE	DATES	NUMBER OF SESSIONS	PRINT WORDS/TREATMENT PHASE
A	1	4/4-4/7	6	
B	2	4/7-4/13	5	little, critter, doll (phrase); yes
B	3	4/14-4/29	5	more, go, I, in, on
A	4	5/2-5/5	5	
A	5	5/5-5/12	5	
B	6	5/13-5/19	5	want, open, turn, my, book
B	7	5/24-5/31	5	red, eat, play, fast, catch
B	8	6/1-6/6	5	car, stop, bird, cookie, cake
A	9	6/6-6/9	5	
B	10	6/10-6/17	5	food, bounce, swing, therapy, story

Impact on Language

The first set of words targeted were chosen based on the initial baseline data which was collected using a preferred text chosen by the student. Throughout the study the student was given the choice of familiar books and consistently showed a preference for stories with “Little Critter Doll” as the main character. After the first treatment phase, words were based both on usage (frequency from the automated data logging system on the student’s device) and those related to the texts with continued emphases on the core high frequency vocabulary. Table 5 displays an overview of all phases and the gradual removal of the symbol leaving only the print word.

Certain words were used more often depending on the text chosen such as “Little Critter Dolls”. The core or high frequency words were initially used more frequently but were not maintained after the picture symbol was removed. Core or high frequency words are used to construct many of our typical sentences and are considered critical in communication and literacy. Table 6 displays all words that were targeted overall for intervention (removal of picture symbol). It is important to note that although many of the words (print only) were not used during intervention sessions, there were several that remained at high or improved frequency. These included;

- “Little Critter Doll”: Baseline 23 vs. Intervention 27
- “yes”: Baseline 17 vs. Intervention 30
- “book”: Baseline 9 vs. Intervention 11

Table 6**Brenden: Frequency of targeted words per intervention phase.**

Words	B1	B2	B3	B4	B5	B6
little critter doll	13	14	0	0	0	0
yes	4	7	7	3	6	3
more		0	0	0	0	0
go		0	0	0	0	0
I		0	0	0	0	0
in		0	0	0	0	0
on		0	0	0	0	0
want			0	0	0	0
open			1	0	0	0
turn			0	0	0	0
my			0	0	0	0
book			4	2	0	5
red				5	0	0
eat				0	0	0
play				0	0	0
fast				0	0	0
catch				0	0	0
car				0	0	0
stop					0	0
cookie					1	0
cake					0	0
bird					0	0
food						1
bounce						0
swing						0
therapy						0
story						0

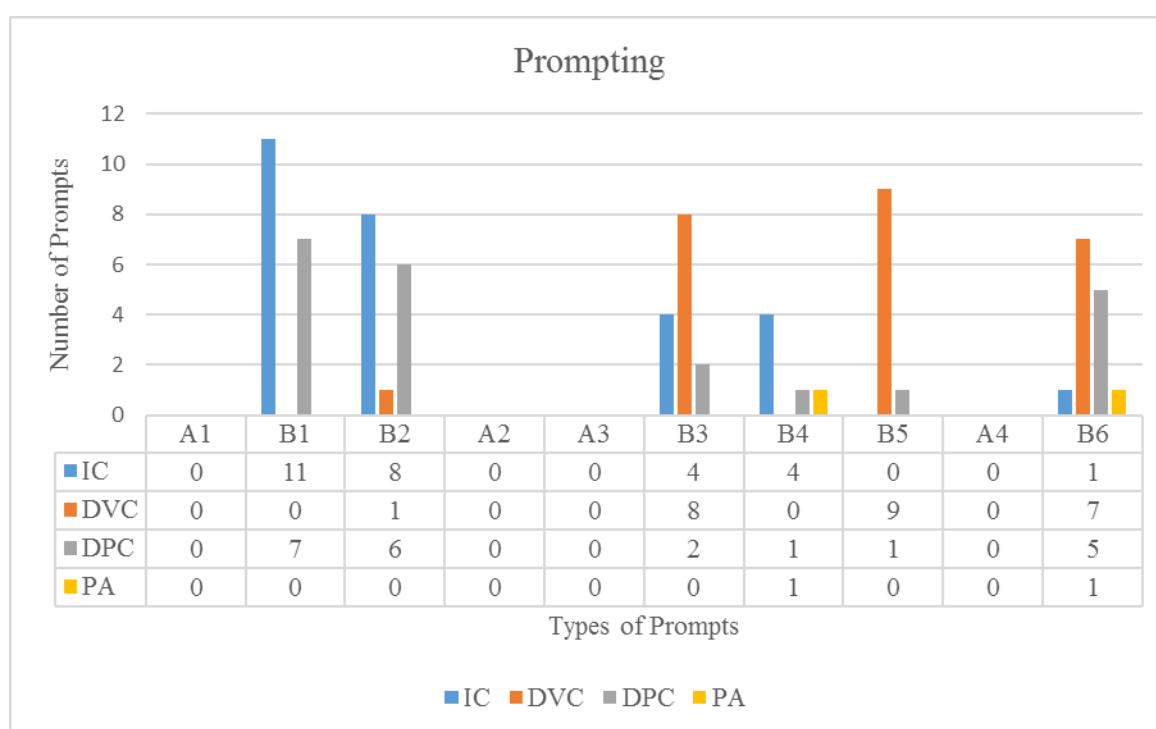
Note: B=intervention phase; Number indicates one of the six intervention phases

Words such as “bounce”, “bird”, “cake”, “stop” and “catch” were used in the original baseline but were not used in future sessions. Based on the data collected by the interventionist, Brenden demonstrated increased vocalizations and word approximations over the duration of the study. Brenden would choose to use vocalizations and word approximations over selecting these same words on his device. This may have influenced

the results of the data collected on the print only words. Given the data collected, it is not possible to tell what this influence may have been. Binger, Berens, Kent-Walsh & Taylor (2008) discussed the potential positive impact of AAC on speech for some students. They found, as did this study in the case of Brenden, that it can support the use of speech.

Figure 1

Brenden: Total number of prompts by level for each phase. Baseline phases were always independent with no prompting. Prompt definitions found on page 10.



Note: IC = Indirect Cue; DVC = Direct Verbal Cue; DPC = Direct Pointer Cue; PA = Physical Assistance; A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

Looking at *Figure 1*, there is a gradual increase in prompting over the course of the study. Prompting was not used during baseline except the initial verbal question. *Figure 1* shows a decrease in independence as more print words were added in the intervention phases. The student required additional rephrasing (direct verbal cue) to assist in

answering the questions. During the final treatment phase direct point cues (DPC) were needed to assist in word finding. At the final intervention phase a total of 27 print words were available to the student.

During both the baseline and intervention phases the interventionist reported inconsistencies in how the student engaged. Brenden is on an individualized behavioral support plan to facilitate improved attention to task, functional communication and work completion. The behavior support plan was followed during the literacy sessions. Common notations by the interventionist included;

- Frustrated because he was verbally saying the answer (prompted to use his communication device in addition)
- Compulsive (student can perseverate on certain words and actions and try to repeat them)

What is important to note in this case is the significant improvement in how he used his device to discuss his feelings and frustrations during the session and throughout the day. This is described in greater detail below as well as in the communication impact section of the results.

Over the initial baseline phase, large numbers of words were selected across most categories. Only the initial question was provided as a prompt. Selections were completely independent and the student was in the process of learning the structure of the literacy sessions. Nouns remained the predominant category of words selected throughout the study. Change is noted more in the accuracy in the selection vs. the number of selections. As mentioned previously, vocalizations increased throughout the study with fewer selections made using the device. Over time the selections were increasingly

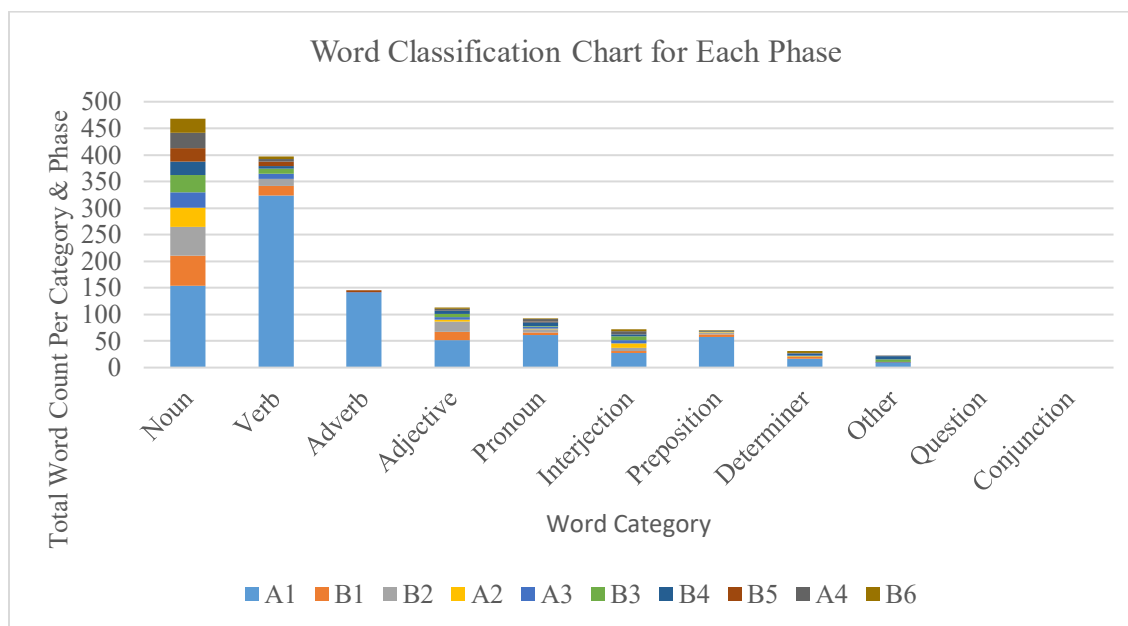
purposeful and included the use of different words such as; happier, sad, hurt, scared, they're, was, likes, sadly and sadder to qualify what he wanted to say. This was a significant finding in the analysis of the utterances and word categories.

Brenden was able to draw upon the main characters of the story and label them correctly. These words tended to be nouns (refer to Figure 2), which accounts for the higher frequency in use. Within the utterances, pronouns were used appropriate such as;

- “I silly”
- “he likes”
- “you went play”

Figure 2

Brenden: Displays the types of words used in each phase as recorded by the language activity monitor and analyzed by Realize Language Software (Prentke Romich Company).



Note: A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

Verbs were selected using present and past tense. Examples include;

- “go play ground....to play ground”
- “is boring show”
- “was mad”
- “we will dog pet”

During one utterance he added the word “and” to extend utterances, (“game and Barney movie”), as well as using the contraction “they’re” correctly; (“they’re animals”). By the last three intervention phases, Brenden was exploring and expanding words and endings. He also produced more repetitive responses that were not related to the questions, book or context. Table A7 provides a detailed transcript of each utterance highlighting the varied words used.

Table A7 (first table in appendix A) documents each phase session, utterance and Brown’s category (Owens, 2016). The tilde sign (~) indicates the use of a prompt to support the response. Incorrect responses (those that do not connect to the story or the question asked) have been highlighted. In addition, repetitive phrases have been noted with parenthesis. This student has a history of repeating the same word or phrase multiple times once it is selected as part of an obsessive-compulsive pattern. It is important to note that the phrases highlighted as not related to the story range from random word selection to attempts to change the conversation. An example is highlighted in the first baseline phase where he mentions game and a Barney movie. It also is an example of hitting the same word twice within a phrase. Email is the most repeated irrelevant word throughout the study.

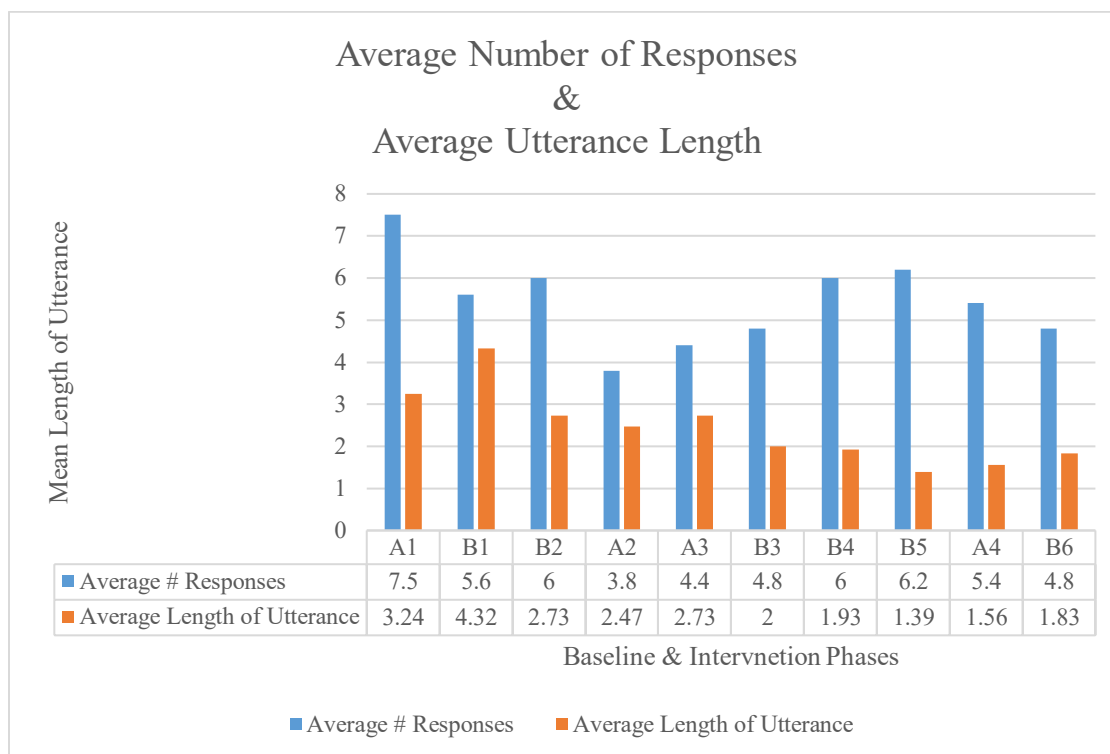
Using the SALT 2016 software package, utterances fall within the early stages of Brown's stages of development (Owens, 2016) to post Stage V. Stage 1 estimates a mean length utterance (MLU) of 1.5-2 with a post Stage V MLU of 4.5 or higher. Not applicable was used for those word combinations that were random which can be found in Table A7. There was a large range of utterances and word usage across the study. The number of utterances ranged from two per literacy session to eleven. Over time the length of the utterance decreased slightly but the accuracy increased with expansion on the use of adjectives, adverbs and verb variation. Examples of more advanced utterances include:

- “need rain sun wind snow”
- “bad weather”
- “we will dog pet”
- “cat feels happy”
- “happy feeling nice.”

The decrease in selections as stated earlier may be due to an increase in vocalizations and word approximations. Brenden's vocalizations increased gradually over the course of the study. By the end he was vocalizing consistently throughout each session. Sigafoos, Didden and O'Reilly (2003) studied the effects of speech generating devices on vocalizations. They found some evidence that suggests the use of SGDs could support the use of vocalizations. During their study one of three student participants began speaking single words. The transcript also demonstrates the consistent use of some of the core words including; yes, help which were selected using the device as well as uttered through verbal approximations.

Figure 3

Brenden: Average number of responses and mean length of utterance for each phase



Note: A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase

Figure 3 represents the average number of responses provided by the student per phase along with the mean length utterance. There is a weak positive correlation between these two variables of 0.165. This means that if the number of responses increases there is potential for the mean length of utterances to also increase. Since there is a weak positive relationship, additional study would be needed to draw more affirmative conclusions. The standard deviation of MLU is .88 with an average MLU of 2.42, while the standard deviation for average number of responses is 1.06 with an overall average of number of responses at 5.45. These are relatively small standard deviations, which indicate the values in each category center around the mean. That is, the data tends to be

stable across both measures. Other notations included behaviors that facilitated more advanced communication functions. Examples include;

- Could not find the word “friend”; asked me to help him...
- Asked for help to find the word “kiss”; asked for help...

Communication and communication functions showed consistent gains across the study.

Impact on Communication

Throughout the intervention sessions there were consistent examples of Brenden initiating asking for help to locate a specific word. In addition, he was able to protest using his device versus engaging in counterproductive behaviors such as throwing or pushing items away. These are noted in the summary of the communication functions pre and posttest based on the Functional Communication Profile-R (Klieman, L. L., 2003). Table B8 (found in appendix B), shows a summary of the pre and posttest assessment of communication functions. The highlighted sections in yellow are specific changes noted in the posttest.

In addition to changes in protesting appropriately and asking for assistance, there were also improvements in the areas of providing information, directing care and commenting. The student quickly learned the structure of the literacy sessions and responded to support in producing more accurate utterances and at times longer utterances. He began to comment on a character’s feelings in the story. The diversity in these comments around the characters in the story and how he interpreted their feelings evolved later in the study. The changes in how he expanded on these communicative functions was seen in his use of vocalizations and his communication device as well as specific word use. The interventionist made comments specifically during the interview

in regards to changes in how Brenden used his device and vocalizations to express himself. The interventionist stated;

He tries and he has actually used his device to tell us when he gets mad when we can't figure out what it is he is saying...which we've never seen him do before....and not really tell us what was wrong but now he'll go in and say like something hurts or he'll say ouch and then he'll go into his device and go to the body parts and find something to let us know and give us a little bit more.

He was able to note character feelings as well as their need for help;

- “He mad.”
- “he help”
- “cat sadder.”

The development of the self-advocacy skills, the expression of feelings and the ability to relate this to the content of a story are significant gains in the area of communication which have been observed throughout the day not just in the literacy sessions.

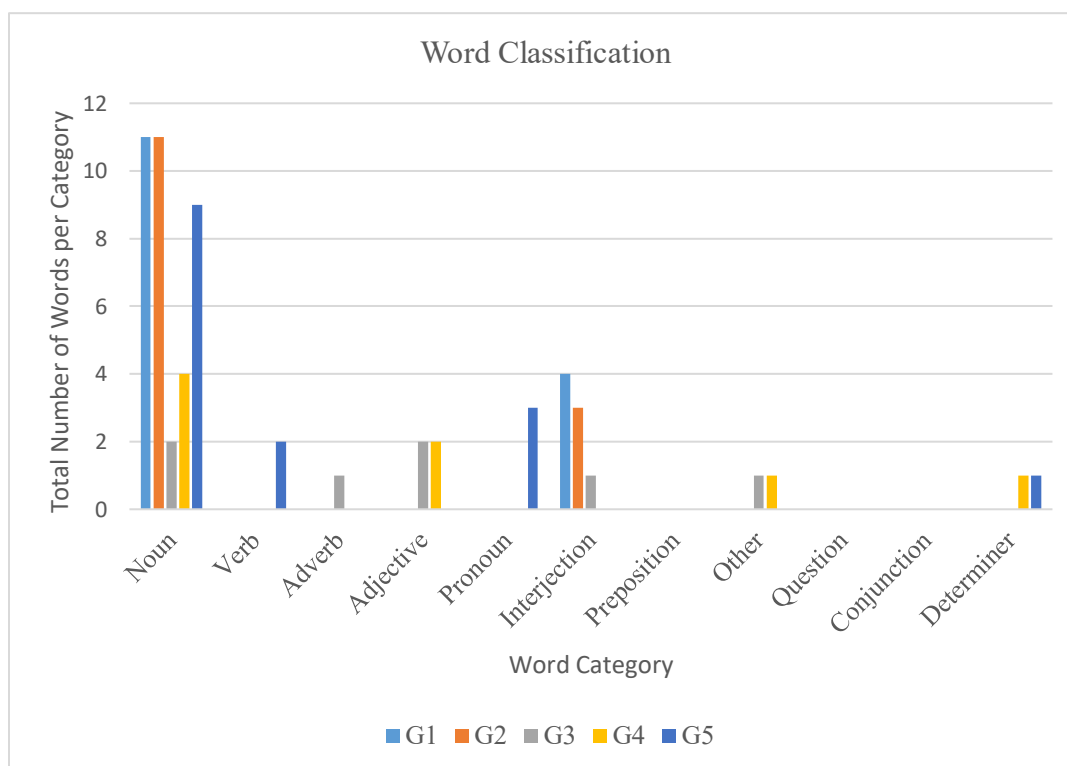
Generalization Phase

The generalization phase for Brenden occurred from 7/18/16-7/27/16. This is exactly five weeks after the final 1:1 literacy session held on 6/17/16. This break also encompasses the school vacation period between the last day of school on 6/17/16 and the first day of the extended school year on 7/5/16. Table C9 (found in appendix C), provides a transcript of the generalization sessions along with Brown's Stages of development. The highlighted sections indicated words that tend to be repetitive by the student. This is consistent between the ten original phases and the generalization period. It is also important to note the print words used during the generalization probes; yes,

book, and story, in addition, words with varied endings and words depicting feelings were also selected including; happier, happy, and sadder.

Figure 4

Brenden: Total Frequency of Word Use Across Categories in Generalization Probes

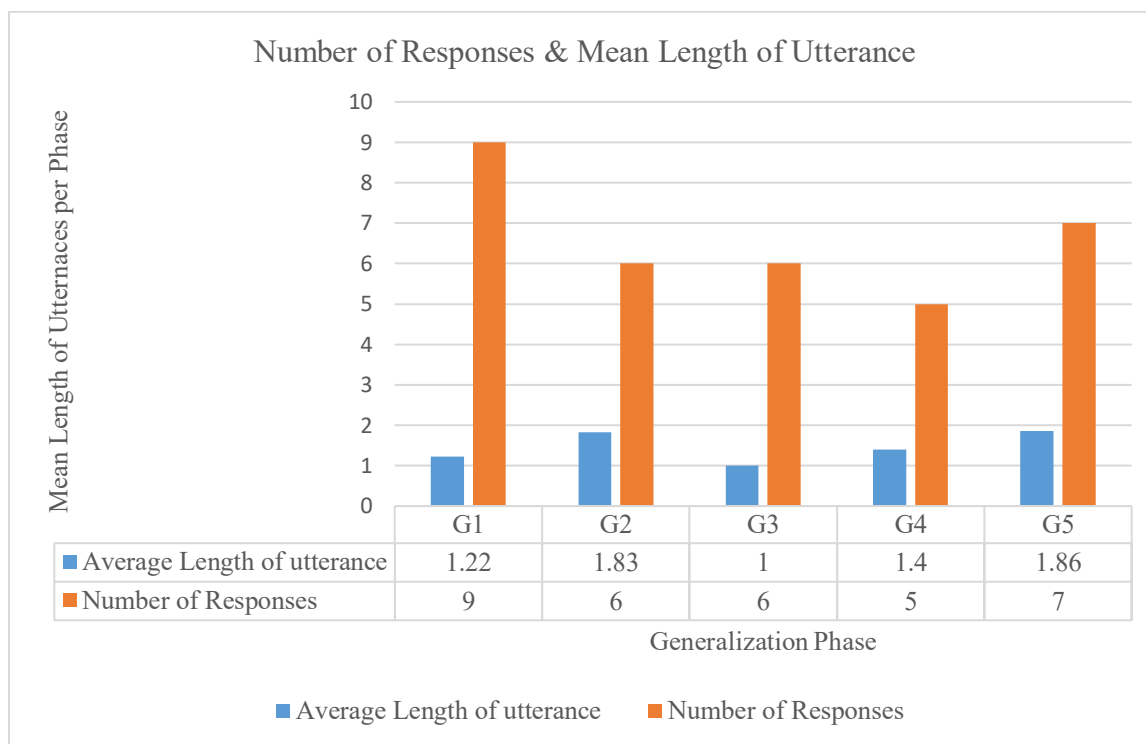


Note: G represents generalization phase; numbers indicate specific phase.

Types of word categories leaned towards more noun usage in the generalization probes. Figure 4 illustrates the range of words used across all five generalization probes. Although the number of words matched the later phases of the implementation portion of the study, the complexity and variation of words was noteworthy. He accurately selected such words as; octopus, whale, bee, caterpillar and butterfly. The one longer utterance used a verb in past tense and third person preposition; “it saw it octopus”. He also constructed short phrases in the future tense such as, “will it”.

Figure 5

Brenden: Total Number of Responses per Generalization Probe and Mean Length of Utterance



Note: G represents generalization phase; numbers indicate specific phase.

Average number of responses and mean length of utterance remained at levels similar to later phases of the implementation portion of the study. Figure 5 illustrates this across the five generalization probes. The standard deviation for mean length of utterance is .377, and with the overall average at 1.47. Utterances generally were one word in length with variations previously noted in terms of phrase construction and word usage. The standard deviation of the number of responses is 1.52 with an average number of responses at 6.6. There is a weak negative correlation of -0.116 between mean length of utterance and number of responses. Given the weak positive relationship previously noted

during the implementation phases, no significant relationship can be described without further investigation.

When looking at all of the data collected during both the implementation phases and the generalization probes, the most significant findings for this student were found within the types of words used and the construction of more complex utterances as well as increased verbalizations/vocalizations and the development of greater self-advocacy skills. The varied forms of verbs, adverbs and adjectives as well as the use of prepositions was consistent and expanded over the course of the study. The influence of the removal of the picture symbol leaving just the printed word was inconclusive for this student.

The following words were consistently used in print format:

- “Yes”
- “Book”

“Little Critter Doll” was not used as the books he chose did not feature this as the main character. This is also noteworthy as for the majority of the study Brenden chose his highly preferred stories which included the: Little Critter Doll: as the main character. Over time he began to make different selections and engage more in the books overall. He did continue to need some assistance but this is in relationship to finding different and more advanced selections.

When looking at the impact on communication, the data reveals consistent gains in key areas that have been noted previously to have carried over into other parts of the student’s day. Self-advocacy skills were demonstrated consistently by Brenden through the use of verbal approximations and his device to ask for help. He also indicated if he did not feel well and he attempted to clarify exactly how he did not feel well if something

hurt. He was able to apply these understandings to characters in the stories as discussed previously.

It is difficult to determine the reasons these words continued to be used versus the others selected. Factors may have included the high preference for stories involving the “Little Critter Doll” and an overall interest in books and stories. During the generalization probes the “Little Critter Doll” books were not selected by the student leaving no opportunity for this phrase to be selected. However; “yes”, “book” and “story” continued to be selected in the print vocabulary format.

Prompting increased during the implementation phases but was much more consistent in the generalization probes. Prompts in the generalization phase centered around the rephrasing of the question as well as supporting the student when he asked for assistance in finding a specific word. The other area prompting was used involved redirecting the student’s frequent selection of such words as email. Email was commonly selected with no apparent intent. The interventionist redirected the student and rephrased or repeated the question when this occurred. It is also important to note that the third and final question in the majority of sessions was answered independently. This involved indicating if he wanted to say something else. The most common answer was no.

Increased vocalization and word approximations were pronounced as the study progressed. This was observed in the generalization probes as well and in the increased skill in the area of self-advocacy. When needed, the student consistently asked for help both verbally and by selecting the word help. Based on reports by the interventionist, this was a significant change. The student was also able to protest/reject in appropriate ways

by using his communication device in combination with vocalization and word approximations.

The interventionist supporting Brenden commented on this during her interview; Absolutely ah so much more vocal...last year he said no I think was the only word that he ever vocalized clearly and now he tries to use vocalization as his full communication with us. She went on to emphasize the change in his use of the device for communication and self-advocacy. The interventionist stated that;

He tries and he has actually used his device to tell us when he gets mad when we can't figure out what it is he is saying...which we've never seen him do before..... but now he'll go in and say like something hurts or he'll say ouch and then he'll go into his device and go to the body parts and find something to let us know and give us a little bit more...

In summary, to answer the primary research questions, Brenden saw gains in the type of language used as evidenced in expanded use of categories of words, tenses and utterance construction. He also expanded upon his communication functions predominantly in the area of self-advocacy. Brenden required some additional support and prompting to initiate responses as the study continued. Given the data collected, it is not possible to completely determine exactly why additional support was needed only that the support was often used to find more complex words after an initiation by the student to receive help. The request for help to find words is a substantial gain. Brenden was taking vocabulary from his chosen text and searching for it on his device. Finally, the impact the literacy sessions may have had on vocalizations and verbal approximations is

significant in terms of communication and language development. These gains were sustained through the generalization period.

Inter-rater Agreement

Inter-rater agreement throughout the study was addressed through the video recordings of four sessions. These sessions occurred on: 4/28, 6/1, 6/10 and 6/16. The average inter-rater agreement was .88 overall with individual sessions recorded at; .79, .87, .91, .93. The researcher and speech and language pathologist reviewed the recordings and noted the student's responses in comparison to the interventionist's recordings. On 4/28 it was noted that the interventionist should more clearly identify which question is associated with which prompt and answer by the student. The prompting was in agreement as well as the notes on specific responses such as;

- Refused device – this was followed by the notation; Verbalizing for the second question with rephrasing by the interventionist. After the rephrasing the student chose “sad”. This was not specifically noted as it was completed independently.

On the second video that occurred on 6/1, the interventionist added in the question notations. The speech and language pathologist along with the researcher felt that additional clarification could be helpful which included indication of exactly how many times a questions was repeated or rephrased. Notations by the interventionist remain detailed and pertinent to the study. Example included; Student requested help to find “foot”; interventionist cued the student to go to the body category. The third video occurred on 6/10 noted the questions and comments in a clearer format. Prompting continued to be in agreement and the additional comments clarified the rephrasing such as for question 2 (What do you think the main character would want you to know about

them?) was difficult as this was a new book the student had chosen. The interventionist rephrased the question, “What do superheroes do?”

The final video on 6/17 had extensive detail that was in agreement with the researcher and the speech and language pathologist. Questions were marked clearly including multiple prompting for the second question with the word the student was having difficulty with noted – “weather”. After each video and review by the researcher and speech and language pathologist, the interventionist was given immediate feedback by the researcher with time to ask questions. Overall there was consistent inter-rater agreement on each video. Direct feedback resulted in changes in data recording to provide greater clarity.

Individual Student Results: Sam

Sam began participation in the study on April 5th with the final phase ending on June 17th. Generalization data was taken between July 18th, 2016 and July 27th, 2016.

Table 10 documents the phase cycle and words targeted for intervention.

Table 10

Sam’s randomized cycle with phase dates and words targeted for intervention (print only) including core words (high frequency) which are highlighted in yellow.

Cycle	Phase	Dates	Number of Sessions	Print Words/Treatment Phase
A	1	4/5-4/12	9	
B	2	4/13-4/28	5	No, he, I
A	3	5/2-5/10	5	
B	4	5/11-5/17	5	You, they, want, the, help, win
B	5	5/18-5/26	5	Like(s), staff, not, high, they’re

Cycle	Phase	Dates	Number of Sessions	Print Words/Treatment Phase
A	6	5/27-6/2	5	
B	7	6/2-6/7	5	Love, same, bad, do, people
B	8	6/8-6/10	5	Baseball, high (high up), weather, body, person
A	9	6/10-6/14	5	Looking, therapy, green, making, science
B	10	6/15-6/17	5	

Impact on Language

Sam is an experienced SGD user and was an active participant in selecting the current device and access method. He chose to switch from eye-gaze to direct point selection which happened approximately six months prior to the study. Sam enjoys reading a variety of books and has a range of interests. Books were rarely repeated at his request and to hold his interest in the literacy sessions. Books tended to have sports or science themes overall. The initial three words are considered part of the core vocabulary and common across all books this student read. They were the most highly used words during the baseline sessions. Core and high frequency content specific words were considered in each intervention phase to be targeted for picture symbol removal leaving only the print word. It is also important to note that this student will attempt to spell words he cannot find or those that may not be in his device. He spells phonetically. At the final intervention phase a total of 30 print words were available to the student. Table 11 displays the use of words across the intervention phases that were specially targeted. Some words appear more often than others due to the text chosen by the student. The student was always given the option to choose which text he would read as part of the study. Some of the words that were more likely to be used based on the text include;

“win”, “high”, “high” (up), “weather”, “baseball”, “body”, “therapy” and “science”.

There was some word targeted for intervention that were selected consistently across the study. It is important to note that these are all core words that remained consistent.

- “no”: Baseline 7 vs. Intervention 42
- “he”: Baseline 6 vs. Intervention 18
- “I”: Baseline 5 vs. Intervention 19
- “they”: Baseline 1 vs. Intervention 17

Table 11

Sam: Frequency of targeted words per intervention phase.

WORDS	B1	B2	B3	B4	B5	B6
NO	6	5	3	4	4	5
HE	0	6	1	1	4	3
I	10	4	1	0	0	2
YOU		0	0	0	0	0
THEY		1	1	1	2	2
WANT		2	0	0	0	2
THE		0	0	0	0	0
HELP		0	0	1	0	0
WIN		0	0	0	0	0
LIKE(S)			1	0	0	0
STAFF			0	0	0	0
NOT			0	0	0	0
HIGH			2	0	0	0
THEY'RE			1	2	2	0
LOVE				1	3	0
SAME				0	0	0
BAD				0	1	0
DO				0	0	0
PEOPLE				0	0	0
BASEBALL					0	0
HIGH (UP)					0	0
WEATHER					2	0
BODY					0	0
PERSON					0	0
LOOKING						0

WORDS	B1	B2	B3	B4	B5	B6
THERAPY						0
GREEN						0
MAKING						0
SCIENCE						0

Note: B=intervention phase; Number indicates one of the six intervention phases

During the study, Sam did choose not to consistently participate in some of the sessions. During the fourth intervention phase he had a more difficult time. It is unclear as to the cause or if it was related to disinterest in the text chosen or the additional demands of the study. One contraction was targeted for intervention: “they’re”. This had some consistent usage throughout the study but was dependent on the utterance and type of response created based on the text. The contraction was consistently used correctly as denoted in the transcript of the utterances in Table A12. Examples include;

- “they they’re going”
- “they’re going to the moon”
- Other times it was used with some syntactical errors. Examples include;
- “they’re letting family”
- “tunnel they’re once”

For the second example the use of the word “they’re” should have been the word “there”.

Word usage is often imitated and over generalization can occur as language develops.

It is particularly important to note that Sam participated almost completely independently with the expectation of needing some of the questions rephrased. Figure 6 shows the summary of the prompting throughout the study. There was only one physical prompt given the entire time. Many of the rephrasing or initial cues which had to be

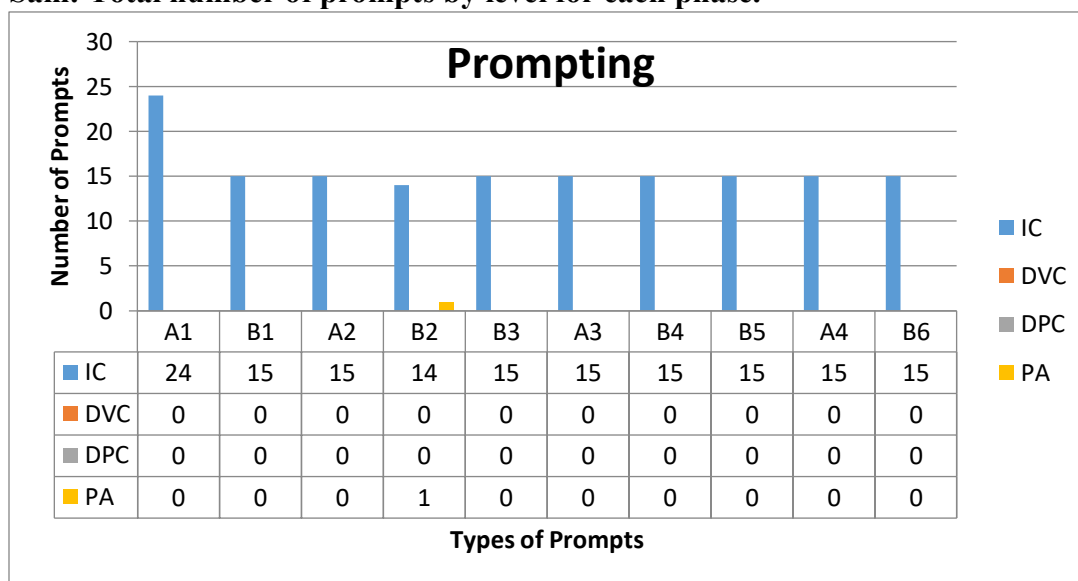
repeated were due to distraction. The interventionist noted this on the data recording sheets.

- Being non-compliant refusing to answer
- Difficulty focusing moved to a quieter area

At times, he would have difficulty stabilizing his hand. The key guard assisted in helping him isolate his selection. In addition, specific positioning supports were in place. Fatigue can make it more difficult for him to make selections along with illness. It is difficult to determine what may have caused the difficulty during a few of the sessions.

Figure 6

Sam: Total number of prompts by level for each phase.



Note: IC = Indirect Cue; DVC = Direct Verbal Cue; DPC = Direct Pointer Cue; PA = Physical Assistance: A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

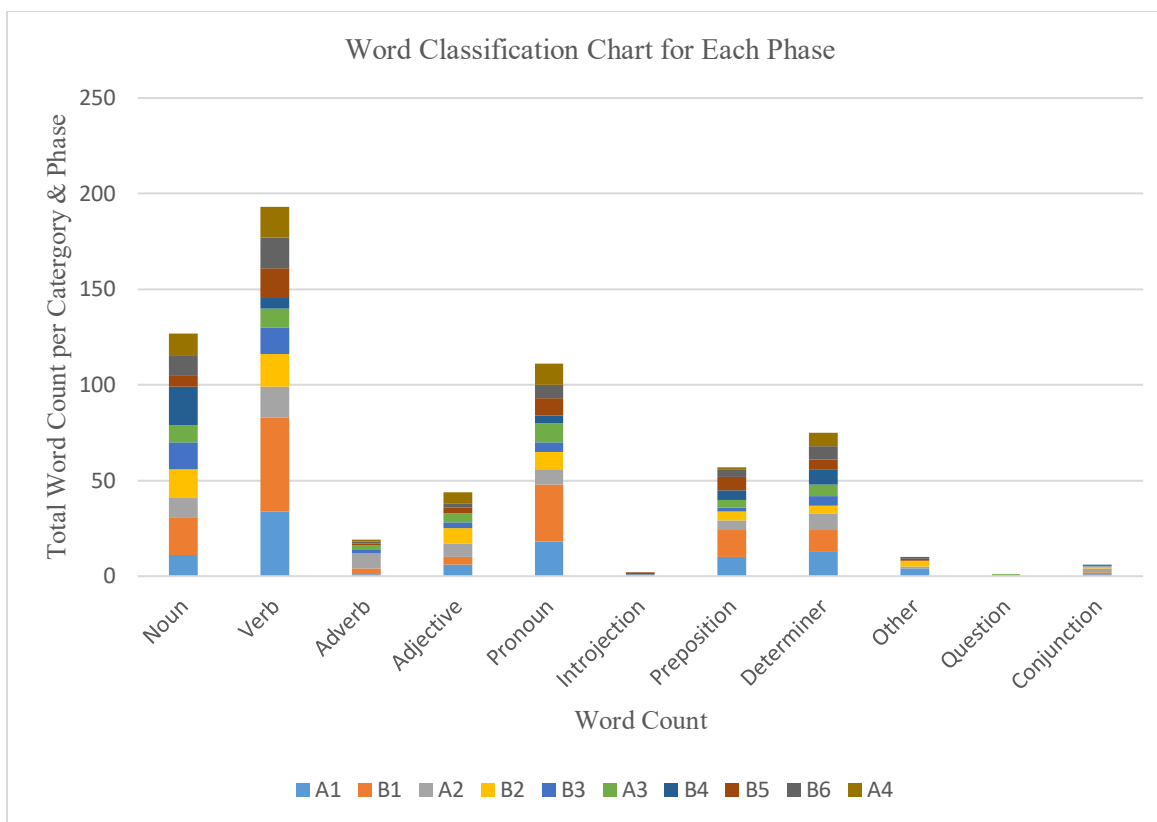
Vocabulary usage was extensive throughout the study. Sam used a full range of word forms to create novel simple and complex responses during each literacy session. Nouns, verbs and both male, female and third person pronouns were most common as presented

in Figure 7. Utterances appropriately combined adjectives, adverbs and prepositions to convey complex thoughts. Feelings were conveyed as they related to the text along with comments to redirect the activity away from the study questions. Examples of complex utterance and those that redirected the discussion include;

- “He likes pop like I do.”
- “They like to win.”
- “I have an emergency” (redirecting conversation)
- “I forgot to exercise.” (redirecting conversation)

Figure 7

Sam: Displays the types of words used in each phase as recorded by the language activity monitor and analyzed by Realize Language Software (Prentke Romich Company).



Note: A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

He used both present, future and past tense regularly throughout the phases of the study.

Examples include;

- “We are going to make the green.”
- “I saw the movie.”
- “They come to help.”

The interventionist noted changes in how he used his device to form sentences throughout the day. Over the course of the study his vocabulary, phrases and communication were impacted across the day. The interventionist noted;

Because he's been refusing even with your project he would only answer with one word... that's if even though we know he's fluent...um, but now he uses full sentences without prompting and communication with the kids and stuff like that. Sam used a lot of phrases involving feelings of the characters and feelings of the interventionist. He was also able to make connections with the main character in some of the stories. Key examples of this include;

- “I feel he felt nervous.”
- “He falls in love.”
- “He was scared.”
- “He likes pop like I do.”

Sam's ability to relate to the text and respond in a meaningful manner is significant.

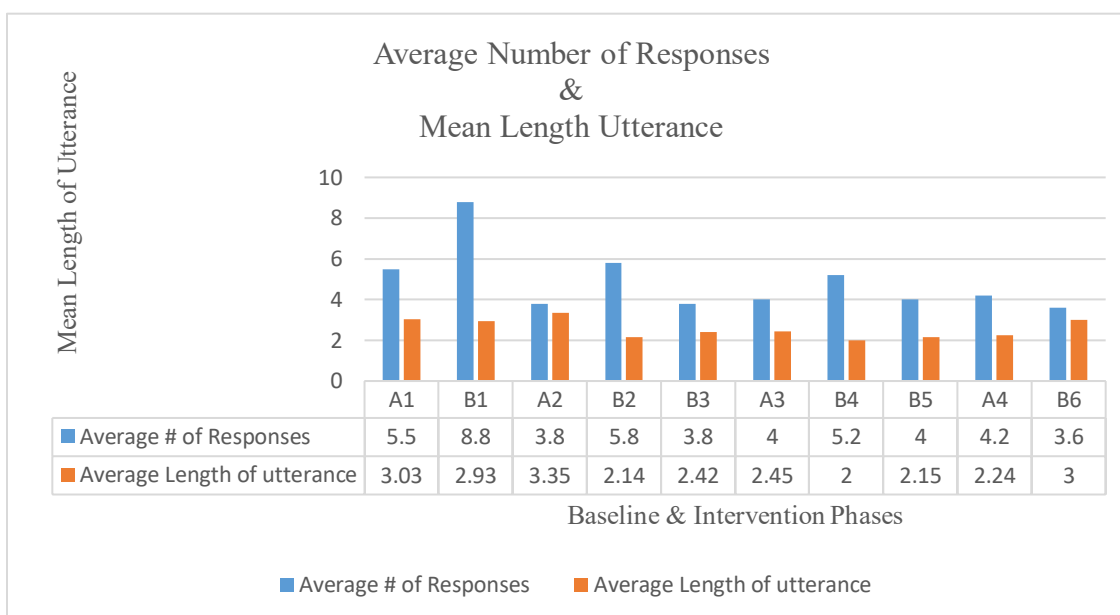
Table A12 (found in appendix A), highlights this. Utterance structure shows an awareness of syntax, which is developing through use and feedback. He is willing to explore new words and attempts to use the keyboard when he cannot find what he is looking for. An example of this is in the first utterance in the initial baseline. He attempts to type the year 2004 and types instead – 2000 4. He understands the basic concept but may or may not have been exposed to enough opportunities to type the year during academics or have had access to consistent visual models of the year.

Figure 8 looks at the average number of responses per phase as well and the mean length utterance (MLU) per phase. Throughout the study the average length of the utterance was on a decreasing trend. Many of the utterances were refined and on target. This includes unique responses such as trying to indicate the sizes of batteries in the June 6th intervention session. There was a 1.59 standard deviation in the average number of

responses and an overall average of 4.87. There were two outliers that influence this. The first baseline and first intervention phase produced much higher responses. The average number of responses after these two phases were much more consistent with a standard deviation of .778. There is a weak positive correlation .155 between number of responses and MLU. At this time this would not be considered significant without additional information and data collection. The MLU overall is stable with a small standard deviation of .467 with an overall average of 2.33. It is important to note that one-word utterances provided were often appropriate and did not require extension as other more complex utterances were describing or responding to the content of the book and his thoughts on it. Overall he would be placed at the Post-V stage of Brown's stages of development (Owens, 2016). Overall he was able to use language effectively to communicate his thoughts. He used a variety of advanced forms of words and is effective in conveying his thoughts around reading content.

Figure 8

Sam: Average number of responses and mean length of utterance for each phase.



Note: A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

Impact on Communication

Sam's participation in the study expanded upon his communication functions that were already present. These expanded skills were carried across other aspects of the day as indicated by his interventionist's quote on page 108. Table B13 (found in appendix B), highlights key areas of growth. It is important to note that Sam is a total communicator and will often use a combination of adapted signs, facial expressions, gestures and his device to convey his thoughts.

Sam was able to expand on a text through specific comments, which are relational to himself and his feelings. As previously discussed in the impact on language section, he was able to interpret the feelings of the characters in the story accurately as demonstrated in his utterances (refer to Table A12 for extensive examples). Sam often used multimodal communication throughout the literacy sessions. He would indicate yes or no through a head nod/shake, adapted arm movement and/or his device. He often confirmed with a

facial expression to the interventionist. During the first inter-agreement video, Sam was informed that he could ask for the video to be stopped at any time. For the first recording only, he stopped the video three times. After each time he indicated when he was ready to have it start again. Sam liked to exercise control and could do so in an appropriate way.

Sam was able to negotiate between multiple boards on his device to find specific words (print and picture based). He combined these words in novel ways and when he could not find a word would ask for help. The ICON tutor (internal mechanism on the SGD to assist in finding words) on the device was used to locate vocabulary. This was done in collaboration with the student so both the interventionist and the student learned how to find words. Sam has continued to become more proficient and efficient in his communication as well as his ability to use his SGD across peers and adults.

Generalization Phase

Sam's generalization phase occurred between 7/18/16 and 7/27/16. This was approximately four weeks after the last literacy session on 6/17/16. As with the other student participants, this encompassed the break between the last day of school and the first day of the extended school year on 7/5/16. Table C12 (located in appendix C), is a transcript of the five generalization sessions. There were similar phrase constructions during the generalization period showing his ability to give an appropriate one-word answer as well as to create more complex utterances. During the first generalization phase he called his interventionist "mean". He did go on and complete the session. In the second generalization session he used a complex utterance, "we love our quiet country" which was relevant to the text chosen. In the fourth session he tried to engage with the

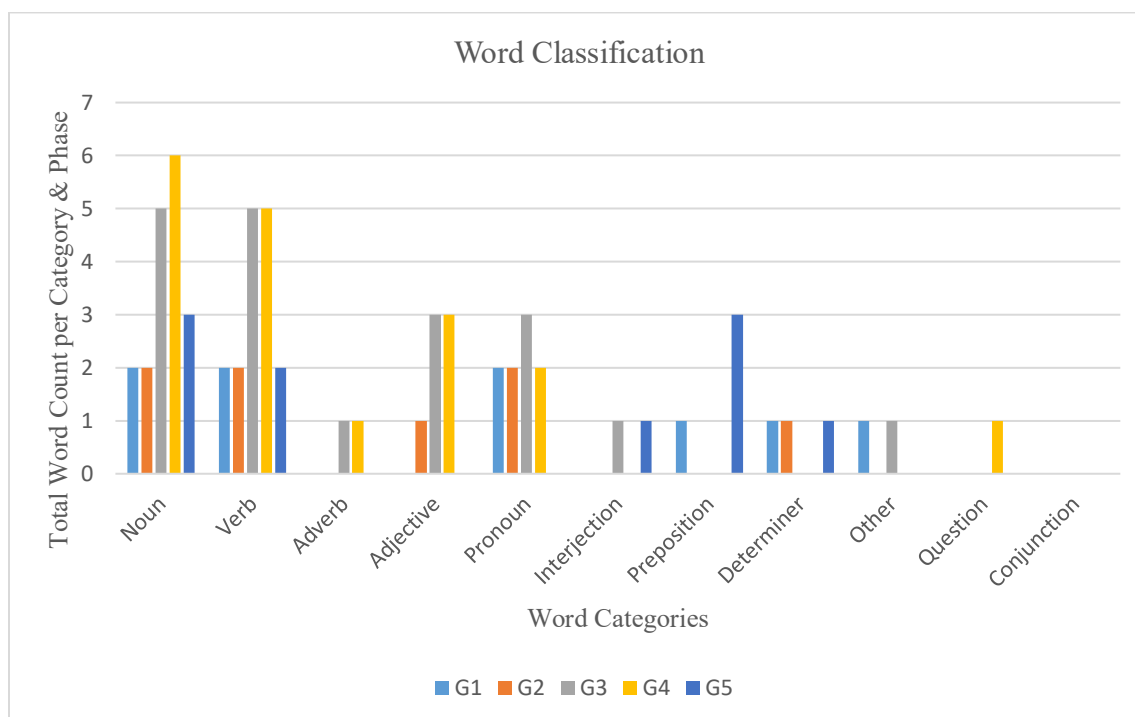
interventionist in a discussion which was evident by the phrases used and the humor applied. Examples;

- “that’s interesting tell me more”
- “just kidding”
- “how are you”

This was also used to redirect the conversation away from the literacy task. Word usage across categories was similar in the generalization phases as displayed in Figure 9. Nouns and verbs were used in various formats with other linguistic categories used appropriately throughout the utterances (refer to Table C14 in appendix C).

Figure 9

Sam: Total frequency of word use across categories in generalization probes.

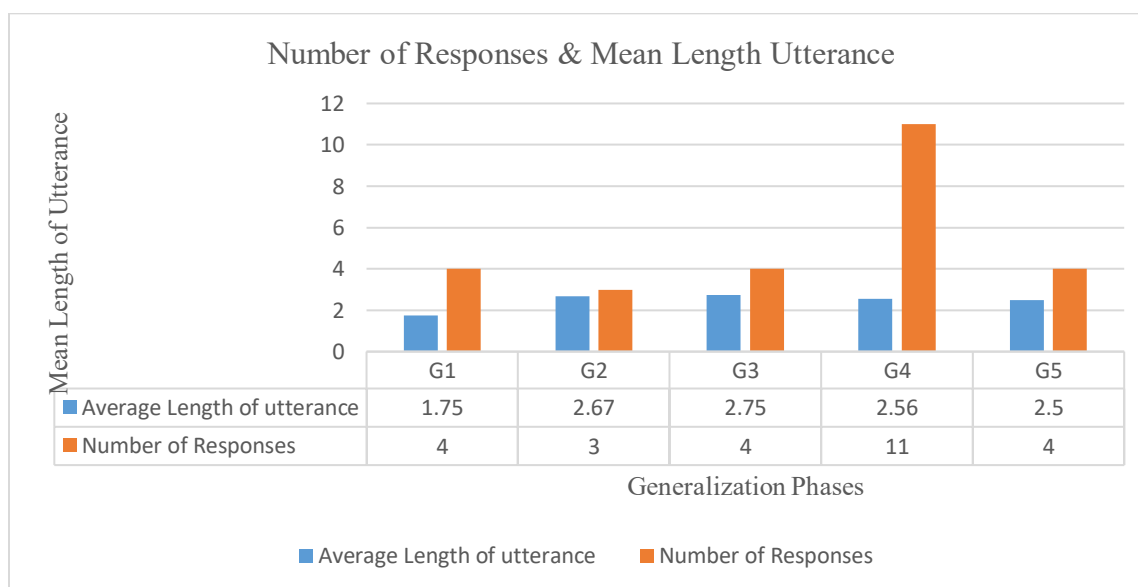


Note: G represents generalization phase; numbers indicate specific phase.

Similar to the intervention portion of the study there remained a very weak positive correlation of .109 between number of utterances and the MLU. No significant relationship can be determined without additional data collection. The standard deviation of .401 for the MLU remained small with an overall average of 2.45. That is, there was very little deviation across patterns of utterance (refer to Figure 10). The range remained stable at one to five words per utterance. The relationship to Brown's stages of development (Owens, 2016) was consistent as well. The standard deviation of 3.27 for the number of responses was impacted by an outlier similar to the intervention phase. When this outlier was removed the standard deviation became .5 with an overall average of responses at 5.2. The outlier session included the social phrases and interactions mentioned earlier and was not representative of his overall responses.

Figure 10

Sam: Total number of responses per generalization probe and mean length of utterance.



Note: G represents generalization phase; numbers indicate specific phase.

Inter-Rater Agreement

Sam was videotaped four times throughout the study to look at implementation and data recording. Videos were completed on; 4/28/16, 6/1/16, 6/10/16 and 6/7/16. The overall average inter-rater agreement was .92 with individual sessions at; .88, .91, .95 and .93. The videotaping of the sessions distracted Sam each time. During the first session on 4/28, Sam clearly understood he had control over the videotaping and asked the researcher to stop three times. During the third session on 6/10 he had greater difficulty paying attention to the text and answering the questions as he was constantly look at the camera each time he answered. This was different from the other student participants who did not look at the camera once the session began. It is difficult to tell how much this may have influenced data collection and the quality of the inter-judgement agreement.

The researcher and speech and language pathologist watched all four videos. The only feedback needed occurred during the first video when the interventionist needed to provide clarity in numbering the questions on the data sheets so that the data could be analyzed correctly. Sam was very independent across the entire study only requiring one prompt and some rephrasing/repeating of the questions. Notations on the data sheet were predominantly related to behavioral concerns including overall distraction from the literacy task. Data sheets were recorded in a consistent format, which was agreed upon by both the researcher and the speech and language pathologist.

Individual Student Results: Holly

Holly began participation in the study on April 6th with the final phase ending on June 16th. Generalization data occurred between the dates of July 18th through July 27th.

Table 15 shows the randomized phase cycle and the words targeted.

Table 15

Holly's randomized cycle with phase dates and words targeted for intervention (print only) including core words (high frequency) that are highlighted in yellow.

CYCLE	PHASE	DATES	NUMBER OF SESSIONS	PRINT WORDS/TREATMENT PHASE
A	1	4/6-4/26	7	
B	2	4/27-5/3	5	Ugly, good, no
B	3	5/4-5/13	5	On, I, me, it, red, shoe
A	4	5/17-5/24	5	
A	5	5/25-5/27	5	
B	6	5/31-6/2	5	Cat, blue, question(s), you, yes
B	7	6/3-6/7	5	Glasses, body, he, would, look
B	8	6/7-6/9	5	Hi, help, mom, button
B	9	6/10-6/14	5	Did, room, pet, very, how
A	10	6/14-6/16	5	

The first set of words targeted were those from a preferred book that occurred most frequently during the initial baseline phase. Holly showed a strong preference for Pete the Cat books throughout the study, which is reflected in the vocabulary used and targeted for intervention. It is important to note that Holly was considered a newer user of the LAMP system as well as eye-gaze access. When the study began, she had only been using her device for a few months consistently.

Impact on Language

Table 16 displays the use of targeted vocabulary words during intervention phases. At the final intervention phase a total of 29 print words were available to the student. Some of the targeted words were significantly reduced or not selected by the student after the print word was all the information available to the student. Other words saw consistent usage throughout the study after the picture image was removed and the print word remained.

These words included:

- “No”: Baseline 27 vs. Intervention 56
- “Cat”: Baseline 11 vs. Intervention 22
- “Blue”: Baseline 6 vs. Intervention 8
- “Yes”: Baseline 7 vs. Intervention 8
- “Button”: Baseline 3 vs. Intervention 8

“No” was used consistently starting in the original baseline. Negation is often seen in early on in development and initial communicative functions and is listed in the early core words (Banajee, M., Dicarlo, C., & Stricklin, S. B. (2003). Since Holly was just beginning to learn how to engage with her advanced SGD, it is not unexpected that negation would be seen in the initial stages. What is interesting to note, is the use of the word “not” in the third intervention phase as opposed to just “no”. The word “cat” was present in all of the stories Holly chose. This word was consistently used and initiated by Holly during most sessions. There were times where she made an error in selection such as picking “chicken” versus “cat”. Her ability to move between selections and dynamic

boards varied at times with errors associated with finding the correct motor pattern and placement of where the word should be related to not reaching the correct dynamic board. That is, she may have been one board away but chose the icon in the exact location on the page that would have been correct if she had moved to the correct board. This was noted by her interventionist. The interventionist stated;

... sometimes obviously she will hit something but you can tell it is in the same spot as the button she would like to pick. So she just like...was one page short of getting where she wanted to be, but you still see the idea that she knows what she is doing. She knows what she wants to get to...what she wants to say.

Holly expanded some of the vocabulary not targeted for intervention but vocabulary that was relevant to the book she had chosen to read. In the fourth baseline she expanded her vocabulary selection significantly and included words such as; “he’s”, “going”, “him”, “know”, and “my”. In addition, she chose to use the word “kitchen” versus the word “room” which was targeted for intervention. She became more specific in her responses that were directly linked to the text being read to her.

Table 16

Holly: Frequency of targeted words per intervention phase.

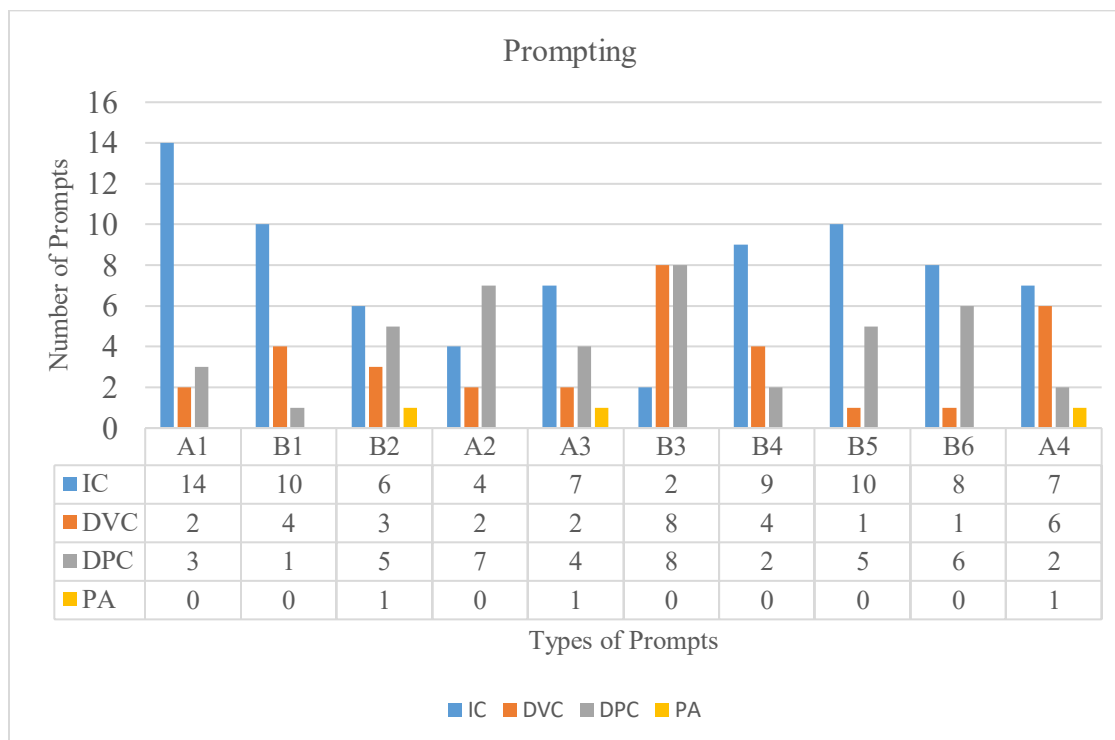
WORD	B1	B2	B3	B4	B5	B6
UGLY	0	0	0	0	0	0
GOOD	0	0	0	0	0	0
NO	30	5	8	4	4	5
ON		0	0	0	0	0
I		2	0	0	4	1

WORD	B1	B2	B3	B4	B5	B6
ME		1	0	0	1	0
IT		1	0	0	2	0
RED		3	0	0	0	0
SHOE		2	0	0	0	0
CAT			5	5	6	6
BLUE			3	4	1	0
QUESTION(S)			0	0	0	0
YES			3	2	2	1
GLASSES				5	1	0
BODY				0	0	0
HE				0	2	0
WOULD				0	0	0
LOOK				0	0	0
HI					0	0
HELP					0	0
MOM					0	0
BUTTON					2	6
DID						0
ROOM						0
PET						0
VERY						0
HOW						0

Note: B=intervention phase; Number indicates one of the six intervention phases

Figure 11

Holly: Total number of prompts by level for each phase. Baseline phases did include some prompting for Holly as this advanced SGD has only been recently introduced.



Note: IC = Indirect Cue; DVC = Direct Verbal Cue; DPC = Direct Pointer Cue; PA = Physical Assistance; A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

Prompting results were particularly noteworthy for Holly. Figure 11 displays the levels of prompting used across all phases. Over the course of the study she required fewer prompts overall. The increase at the end in the direct verbal cue related to the need for rephrasing and repeating of the questions. This resulted in the use of more advanced and specific vocabulary as noted earlier. Holly was increasingly proficient in how she was able to respond as the study progressed. The changes in the support using the direct point cue varied based on the vocabulary Holly was seeking. Many times Holly struggled with reaching the correct board to make the selection she was seeking. This can also be

attributed to the need for additional practice in eye-gaze targeting as this was a new access method for her. Her interventionist noted some of this on the data recording sheets;

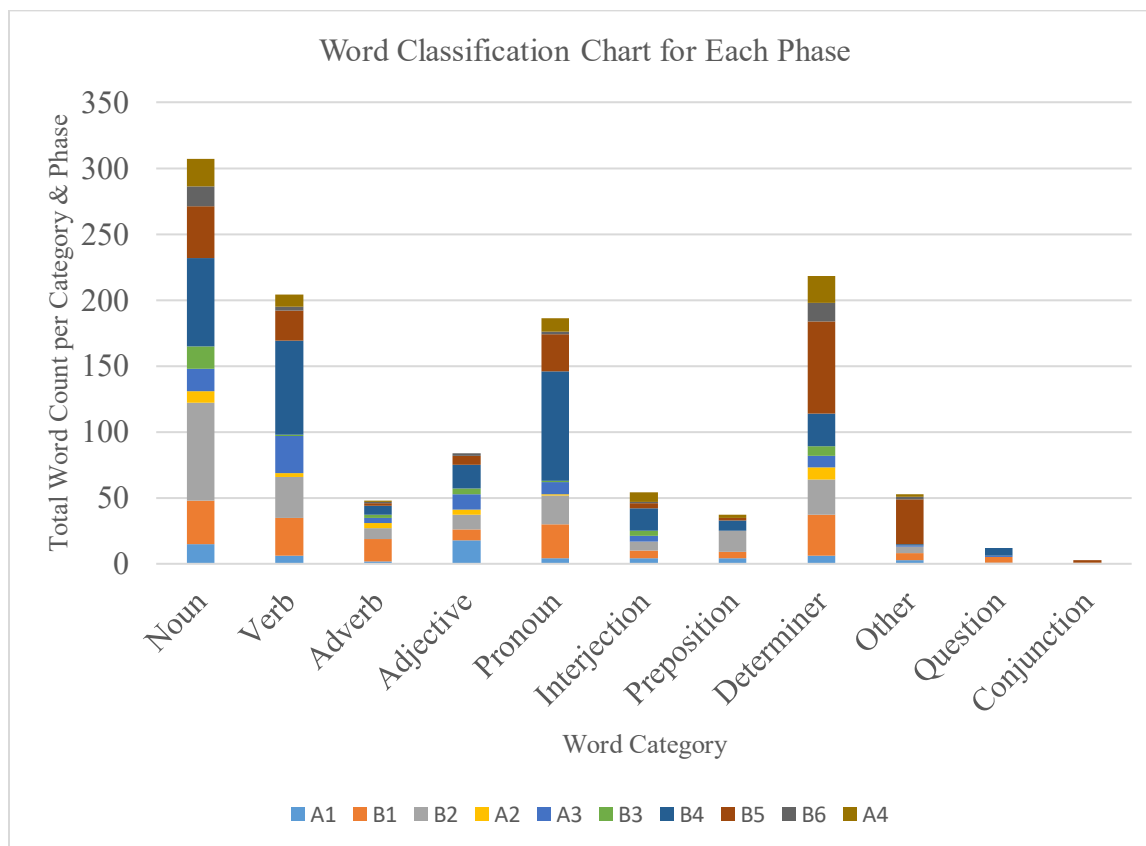
- prompted to specific pages, struggled at times to hold gaze long enough to activate
- student said dog, made wrong selection on correct page, required prompting to correct word

Holly demonstrated a consistent balance of nouns, verbs and pronouns including possessive (I, me, my, he, his, it, its) as indicated in Figure 12. Pronouns increased over the course of the study and were used appropriately (refer to Table A17 in appendix A) which presents the utterances over the course of the study). An example of how vocabulary advanced includes;

- “He needs.”
- “Near telephone.”
- “He does.”
- “He wants.”
- “I have.”

Figure 12

Holly: Total frequency of word use across categories for baseline and intervention phases.



Note: A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

Holly used a variety of words and short phrases to engage in each session. She ranged in Brown's stages (Owens, 2016) from I to Post-V with most utterances falling within the I-III range. Some phrases were preprogrammed but were used correctly during the session. The tilde ~ in Table A17 is used to mark words that required additional prompting beyond the initial verbal cue or rephrasing. The majority of words chosen were relevant to the context. Introducing herself and social interactions were considered

relevant especially when presented at the beginning of the session. Holly also showed changes in the application of adjectives, adverbs and verbs. This included asking to call her teacher to show her the good work she had done in the session. Examples include;

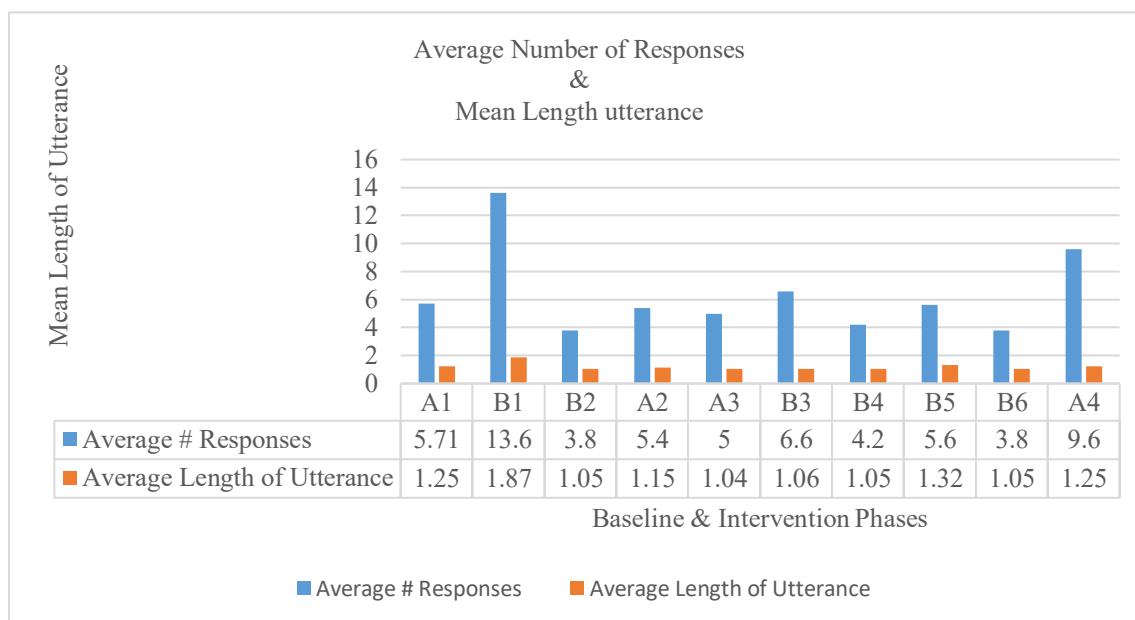
- “He’s going”
- “Clothing button”
- “Telephone Ms. Mary”
- “I have”
- “Pig fast”
- “Color could I”

The ongoing exploration of words and expansion of syntax was particularly impressive especially since the student had limited experience in using the advanced SGD and more advanced communication systems overall. Her MLU across the ten phases ranged from 1-3 words (see Figure 13) with an overall MLU of 1.31 in Brown’s Stages I through III (Owens, 2016). The Post-Five responses were programmed phrases that were not counted for the purposes of this study. Figure 10 represents the average number of responses provided by the student per phase along with the MLU. There is a weak positive correlation between the MLU and the number of responses per phase. There is insufficient information to know if this is significant for this student especially in light of a higher standard deviation of 3.06 in number of responses. There is a large range between phases from an average of 3.8 responses to 13.6. The standard deviation of the MLU is significantly smaller at .25. This means that most MLUs did not move far from the mean. Throughout the intervention portion of the study, Holly’s MLU remained consistent with an average range of 1.05-1.87. Changes in terms of impact on language

were measured better by the changes in vocabulary used and in simple word combinations as indicated earlier.

Figure 13

Holly: Average number of responses and mean length of utterance for each phase.



Note: A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

Impact on Communication

Communication was significantly impacted throughout the study as evidenced by the ratings on the Functional Communication Profile-R (Klieman, L.L., 2003) summarized in Table B18 (located in appendix B). The one over-riding factor across all progress in this area was Holly's independent initiation to communicate during her literacy sessions as well as throughout the day. The interventionist noted;

She can now have a conversation with anyone her peers like to talk to her like they'll say like, "hey what's up" and she be like. "hi like how are you" and just like that whole conversational thing she has students that sit around her now that

before would obviously try to talk to her but now she'll actually communicate back and you can tell like she is really into it like she'll smile she gets so excited so that is definitely a huge piece that she got of it and just me seeing one of my kids do that it's like phenomenal.

Holly used student and staff names when calling for them. This was seen in one of the literacy sessions when she requested to, "telephone Ms. Irene" who is her teacher. She also requested specific activities and items using her device. This included making a request for the 1:1 literacy session when her interventionist was out or when the interventionist was present and she wanted to do a session. Her interventionist noted that, "She asks for it when I am not in she will ask for Pete; oh you want to read the book. Ok well let's do some work".

The other part of communication that has been impacted was the willingness of the student to explore more communication boards versus previously relaying on just the first one or two which were easier for her to navigate. The interventionist notes this in the interview.

...and just to see like how detailed it is you have to go to page to page to page to get to this button and the fact that she knows how to do all of that I am good for you, you little rock star like she's awesome, and like I said she wasn't doing that. She would do buttons that wouldn't take much effort to get to. She would say things but now it is like oh I want to have a full conversation with this person... I want to ask how they're doing... well I have to get to this button to the communication button to conversations and then you pull up... like it's really really detailed what she does now which is different from before.

This was also demonstrated in the changes in the vocabulary used which required much greater navigation throughout the device as well as exploring more familiar categories in greater detail such as animals.

Finally, Holly has become a much better self-advocate across the study. She will use her SGD across activities and initiate interactions, requests and comments without prompting. These skills have improved her communication and ability to navigate her world with less adult support.

Generalization

The generalization phase for Holly occurred from 7/18/16-7/27/16. This is a little over 4 weeks from her last session on 6/16/16. The breaks include the last day of the regular school year on 6/17/16 and then the start of the extended school year on 7/5/16. Table C19 (located in appendix C), is a transcript of the five generalization sessions with Brown's stages of language development. There are several significant findings from the generalization transcript. First, language and communication gains were maintained. What is particularly noticeable is the ongoing exploration of words. Several examples include;

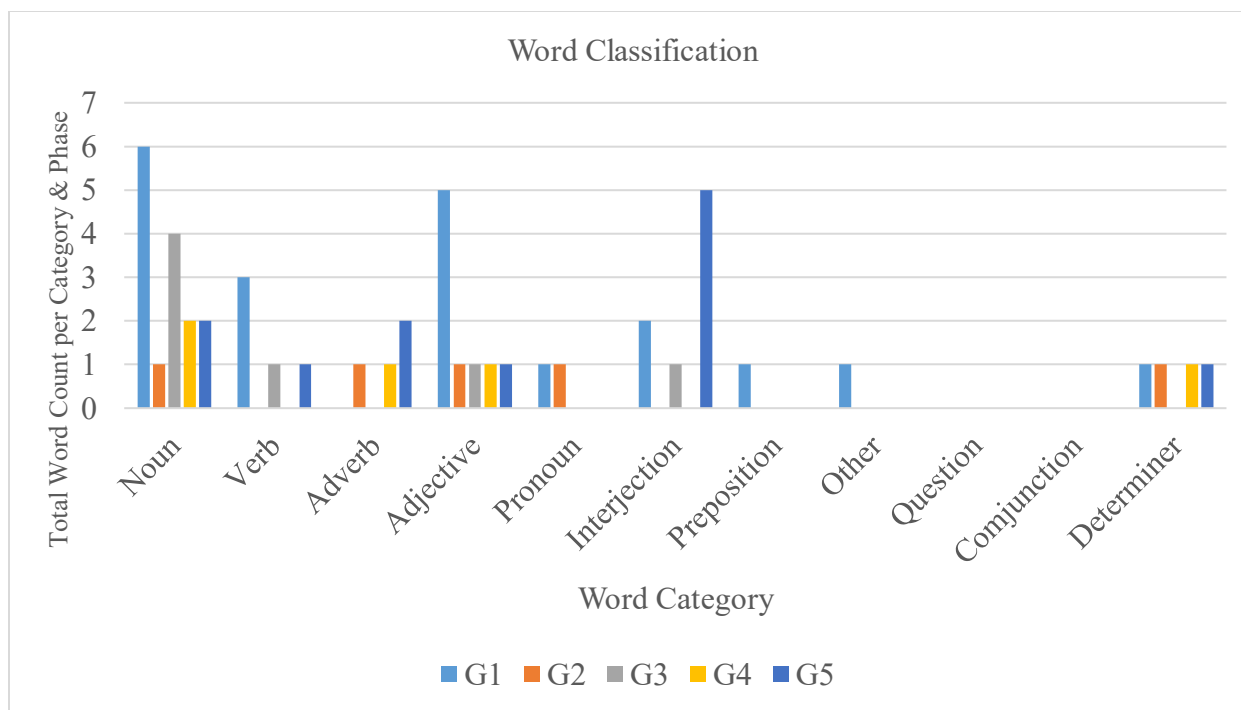
- “hi hi heels” (trying to say high heels)
- “orange (possible error) yes, yes, maybe, maybe, no” (in response to third question – Do you want to tell me something else about the book?)
- “look cat”

The attempt to indicate the type of shoe was interesting as she used her phonemic awareness to convey high heels from the story. This shows ongoing advances in her understanding of vocabulary and her device. Figure 14 specifically looks at the word

categories used in the generalization sessions. Holly engaged with a variety of word categories to expand how she formed various utterances documented in Table C19 (found in appendix C).

Figure 14

Holly: Total frequency of word use across categories in generalization probes.

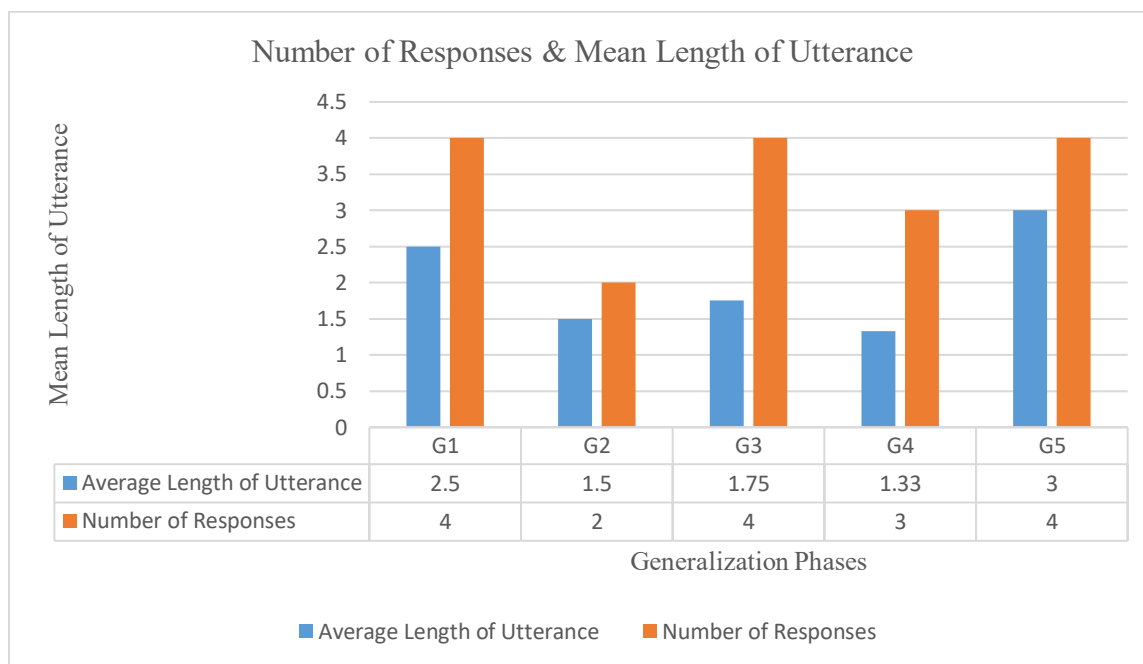


Note: G represents generalization phase; numbers indicate specific phase.

In Figure 15 the MLU ranges from 1.5-3 words. There is a weak positive correlation between the number of responses and the MLU. The standard deviation of .894 across number of responses is much smaller in the generalization probes with an overall average at 3.4. This may be a function of fewer probes versus an actual change in how responses are given. The standard deviation in the MLU remains small at .709 with an overall average of 2.02, showing little variation with the exception of three outliers with lengths of four words each.

Figure 15

Holly: Total number of responses per generalization probe and mean length of utterance.



Note: G represents generalization phase; numbers indicate specific phase.

Words noted during the intervention portion of the study continued to be used in their print format with the exception of button which was not part of the stories read during generalization. These included;

- “No”
- “Cat”
- “Blue”
- “Yes”

This demonstrates some degree of maintenance in print vocabulary over time. This is significant given the short period of time this student has had access to a more advanced SGD.

In summary, Holly has seen significant gains in both the area of communication and language across the study through the generalization period. She has increased independence across various communicative functions and has expanded the vocabulary she will access and use throughout the day. Holly will initiate various interactions and has shown she will invest effort into exploring new boards requiring much more extensive navigation on her device.

Inter- Rater Agreement

Inter-rater Agreement was conducted through the use of four video-taped sessions throughout the study on 4/29, 5/31, 6/14, and 7/19. Overall average inter-rater agreement was .85 with individual sessions at; .78, .82, .88, and .92. The researcher and speech and language pathologist reviewed the data recording sheet form each video-taped session. As with other student participants, the interventionist needed to be clearer in recording the exact question the comments and prompting were referring to. This feedback was given immediately and changed made. Prompting was very consistent with only two exceptions noted across all for videos. Clarification was provided as to how the pointer is used to support the student's eye-gaze and how that should be recorded. Sessions were conducted consistently and the researcher and speech and language pathologist agreed on the recording of the information and the few exceptions and feedback needed for the interventionist. Agreement looked at exact prompting levels, comments and specific words recorded that required assistance.

Individual Student Results: Cameron

Cameron began participation in the study on 4/6/16 with the final phase ending on 6/17/16. Generalization data was collected during 7/27/16 through 8/3/16. Generalization

data was collected later due to the student's family vacation. The data was collected five and one half weeks from the intervention session on 6/17/16. Table 20 summarized Cameron's randomized cycle with phase dates along with the words targeted for intervention (print only). At the final intervention phase a total of 30 print words were available to the student. The highlighted words are considered core words or high frequency words.

Table 20

Cameron's randomized cycle with phase dates and words targeted for intervention (print only) including core words (high frequency) which are highlighted in yellow.

CYCLE	PHASE	DATES	NUMBER OF SESSIONS	PRINT WORDS/TREATMENT PHASE
A	1	4/6-4/28	9	
B	2	5/2-5/11	6	The, goat, hungry, eat, yes, no
B	3	5/12-5/23	5	Book, all done (phrase and individual words), hungrier
B	4	5/24-5/26	5	Please, puppy, dog, blue, cat
A	5	5/27-6/1	5	
A	6	6/1-6/3	5	
B	7	6/6-6/8	5	Shoe, hi, flower, ball, play
B	8	6/9-6/13	5	Frog, playing, saw, sandwich, story, toy
B	9	6/13-6/15	5	Of, I, lunch, had, want
A	10	6/15-6/17	5	

Impact on Language

The first set of words chosen targeted primary core words and two words from the preferred book the student was reading. This student read silently during the entire study. The interventionist pointed to each word on the page to support visual tracking only. No words were read aloud. Cameron prefers high levels of consistency with limited variation

in the books that were used for the study. This is important to note when looking at vocabulary usage acquisition and utterance formation.

Cameron was able to consistently use a variety of the targeted words throughout the study with greater independence. Cameron was able to maintain many of the core and content related words in print only (picture symbol removed). Usage of content specific words changed based on the text being read. “Goat”, “puppy” and “sandwich” were all associated with specific texts. These words were used when the related text was being read. Most common print words used throughout the study include;

- “yes”: Baseline 6 vs. Intervention 16
- “no”: Baseline 6 vs. Intervention 20
- “all done” Baseline 1 vs. Intervention 66
- “puppy”: Baseline 0 vs. Intervention 53 (relevant character in new book in the third intervention phase)
- “sandwich”: Baseline 1 vs. Intervention 11 (introduced in the fifth intervention phase associated with a text)

It is important to note that although Cameron can read print, he was not familiar with print associated with his communication device. During the study he quickly began making these associations for the core words and text specific words. Table 21 shows the overall frequency of targeted words per intervention phase.

Cameron was very independent throughout his cycle. Figure 16 summarized the prompting used across all phases. There was a gradual decrease in prompting overall as the routine and expectations of the literacy sessions were learned. This is also a reflection of the consistency in the texts used based on his preferences.

Table 21**Cameron: Frequency of targeted words per intervention phase.**

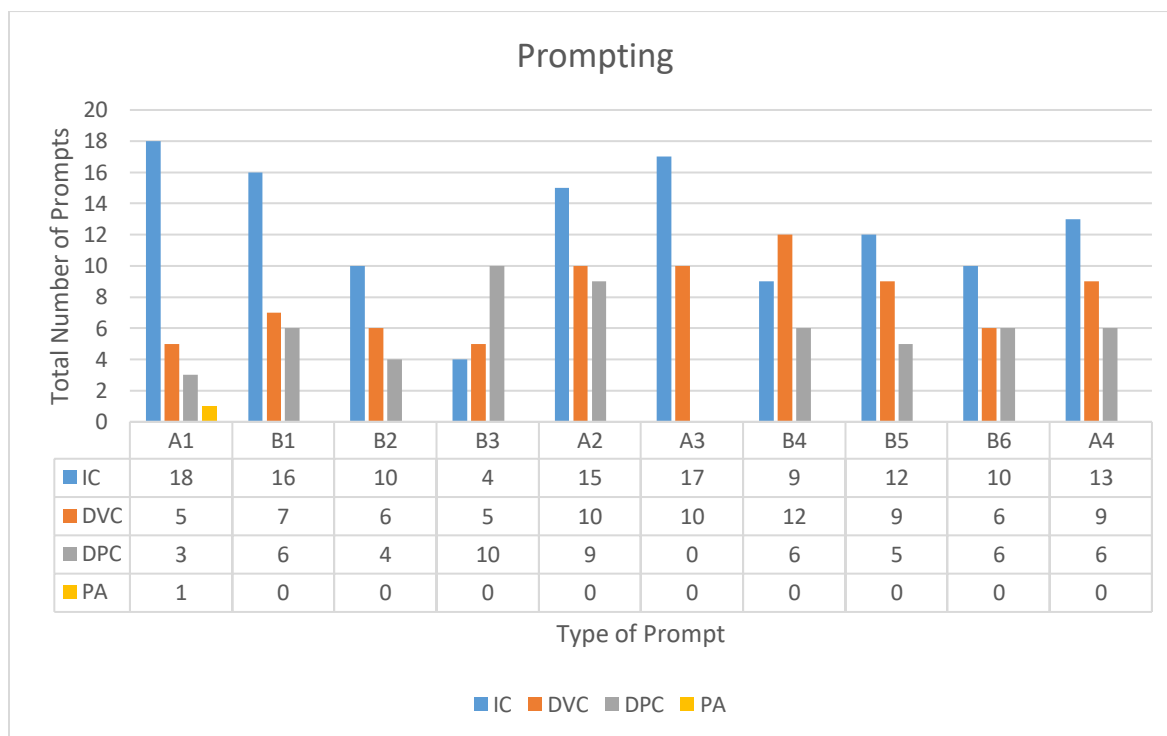
WORDS	B1	B2	B3	B4	B5	B6
THE	25	23	9	13	8	7
GOAT	21	20	5	0	0	0
HUNGRY	19	20	5	4	0	0
EAT	5	8	1	1	0	0
YES	13	2	0	0	0	1
NO	11	1	1	1	2	2
BOOK		2	1	0	0	0
ALL DONE		6	7	9	7	8
HUNGRIER		1	0	0	0	0
PLEASE			3	2	5	5
PUPPY			5	10	4	4
BLUE			0	0	0	0
CAT			0	0	0	0
DOG			4	0	0	1
SHOE				0	0	0
HI				0	0	0
FLOWER				0	0	0
BALL				0	0	0
PLAY				2	0	0
FROG					1	0

WORDS	B1	B2	B3	B4	B5	B6
PLAYING					0	0
SAW					0	0
SANDWICH					7	4
STORY					0	0
TOY					0	0
OF						1
I						1
LUNCH						0
HAD						0
WANT						0

Note: B=intervention phase; Number indicates one of the six intervention phases

Cameron only required one physical prompt during the entire implementation phase of the study. Most additional prompting involved repeating the question more than one time (IC). The direct verbal cues (DVC) were given to support vocabulary location followed by the direct point cue (DPC) if he asked for assistance in finding a specific word. Other times he needed to be directed to use his SGD when exhibiting avoidance behaviors (covering his face with his hands) or attempting to use verbal approximations. The SGD was used to confirm any verbal answers given. Examples of some of these scenarios from the data sheets include;

- Asked for help after the question was asked
- Directed to use talker
- Signed help – prompted to use device

Figure 16**Cameron: Total number of prompts by level for each phase.**

Note: IC = Indirect Cue; DVC = Direct Verbal Cue; DPC = Direct Pointer Cue; PA = Physical Assistance; A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

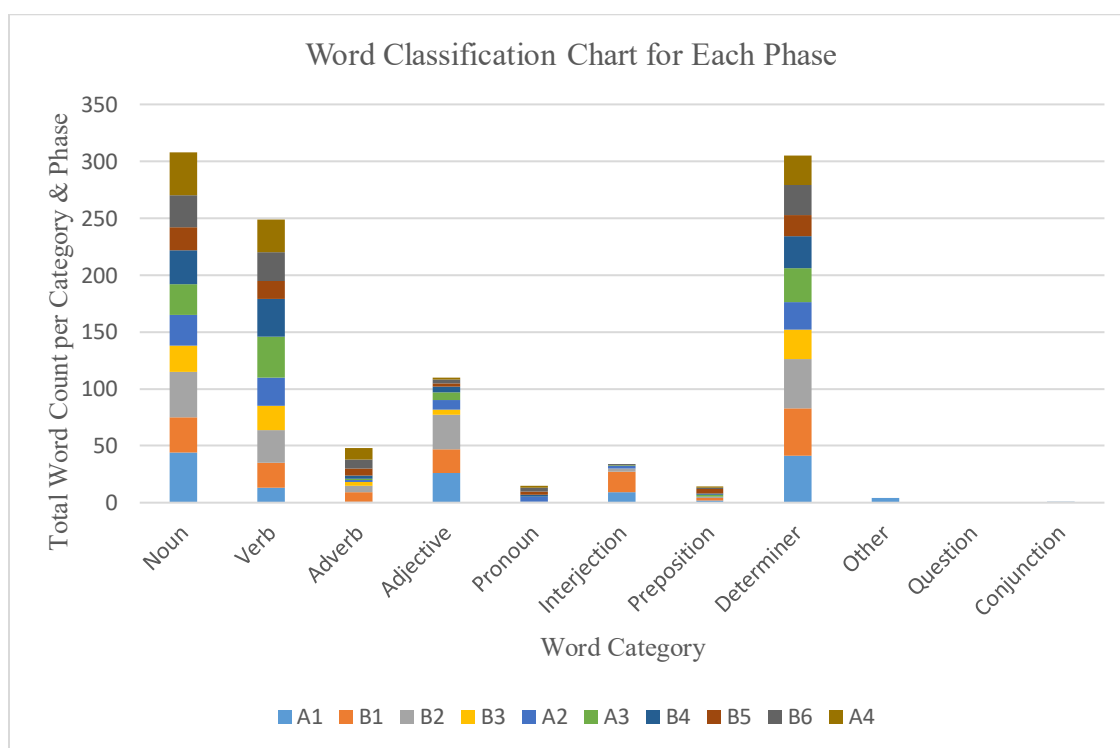
Cameron used a variety of word categories during the study. He used the word “the” very frequently therefore making the determiner category very high. With this exception, the main categories fall within the noun, verb, adjective and adverb. He used a variety of forms of each as displayed in Figure 17. Examples include;

- “hungrier”
- “ate” vs. “eat” – each used correctly in the utterance.
- “reads”
- “saw”

The word combinations and phrases used were at times repetitive but directly related to the text read. Table A22 provides a transcript of the utterances and words used during the ten phases. Cameron made small variations on how he expressed words and combined them to convey his thoughts. An example was the use of either hungry or hungrier when describing the goat in the story. He added in words like condiments when he could not find ketchup and was able to find the word lettuce when talking about a sandwich.

Figure 17

Cameron: Displays the types of words used in each phase as recorded by the language activity monitor and analyzed by Realize Language Software (Prentke Romich Company).



Note: A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

Cameron initially used the word “no” during the sessions but very quickly switched to “all done” especially as it related to the last question in the literacy session which asked if he wanted to say anything else. Over time “all done” was used in the middle of sessions as well and at one point he added in a bit of humor by saying, “I’m of course all done”. He learned quickly to ask for help using his device and added the word “please” many times to this request. He also explored words by adding hungry or hungrier to other animals such as cow, rooster, skunk and puppy. He put together more complex sentences using emerging grammatical functions and varied verb tenses. In Table A22 (located in appendix A), the tilde sign (~) indicates the use of a prompt to support the response.

Some pertinent examples are;

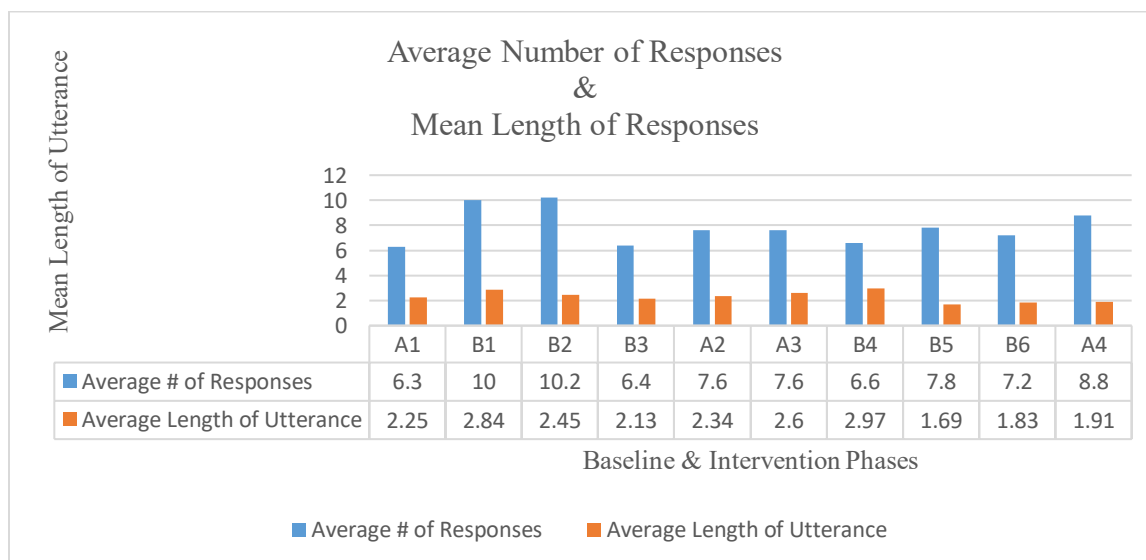
- “help story please:
- “the hungry goat all done”
- “had lettuce on it”
- “no, I all done”
- “the play playing puppy”

Utterances overall ranged from single words to nine words falling with the first to Post-V stage of Brown’s stages of development (Owens, 2016). There was a weak positive correlation of .164 between the mean number of responses per phase and the MLU. This is not considered significant given the data collected. The number of responses had a larger range across the study with a standard deviation of 1.4 and an overall average of 7.85. The average responses per phase ranged from 6.3 to 10.2. At times this was reflected in the repetition of responses focusing on specific content in the

story through rephrasing and word exploration by changing word order or adding endings. The standard deviation of the utterances was quite small at .436, which indicates that most responses were close to the mean with minimal variations except for several outliers. The overall average for MLU was at 2.3. These outliers included rephrasing of the same answer for example, “the hungry goat the hungry goat the”. Other utterances included the phrase, “all done” in a potential attempt to end the literacy session sooner. This particular utterance is an example of expanded communicative intent demonstrated during the study. Figure 18 summarizes the MLU and mean number of responses per phase.

Figure 18

Cameron: Average number of responses and mean length of utterance for each phase.



Note: A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

Impact on Communication

Cameron came into the study with strong functional communication skills that were at times difficult to access due to the need for strong structure and routine with little variation. His biggest area of improvement as with all of the student participants was in the area of self-advocacy. This was seen particularly in the ability to ask for help using his device. His interventionist specifically mentioned this in her interview that, “He definitely has gotten more flexible in asking for help in using the device... there were a lot of times before he would get if he didn’t know where something was he would rely solely on signing”.

When referring to Table A22 where the transcript of the utterance is listed, you can see the number of times Cameron used his device to ask for help. Initially he required prompting from the interventionist to use his device. Over time he was able to independently initiate asking for help when he could not locate a specific word. Table B23 (located in appendix B), reviews some of the communicative functions that expanded during the course of this study including functions associated with self-determination and advocacy. Cameron would sign the word “help” as well as indicating it on his device. Learning how to find words was directly modeled for him by the interventionist.

The interventionist stated;

...or when using the device if he can’t find the words [he will] sign for help and we can go to the icon tutor... and type it in and his response to me... oh we’re going to find the word now.

Having a consistent response in how help can be requested and how words can be found to communicate more effectively can assist in reducing frustration, which Cameron can exhibit when engaged in a challenging or non-preferred task.

The other area that he was able to expand on was in appropriately requesting to be “all done”. Cameron consistently used his device for this and showed humor as mentioned earlier one of the times. This was a change from the initial phases where he selected the word “no” to indicate he was done and had nothing else to say. This was demonstrated beginning in the first intervention phase. Cameron consistently demonstrated the ability to comment on a text with growth being in the area of independence in forming each of the utterances.

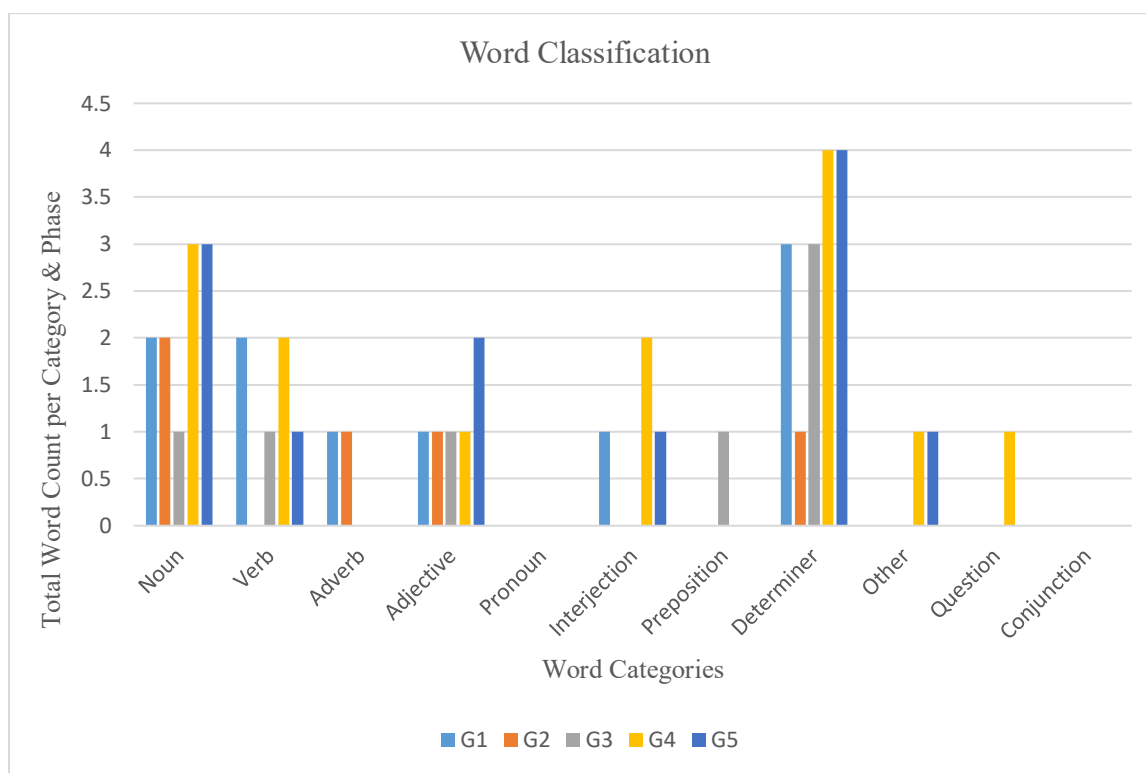
Generalization Phase

Cameron participated in five generalization sessions from 7/27/16 through 8/3/17. This is about five weeks after the final session on 6/17/16 and includes the break between the last day of school and the first day of the extended school year on 7/5/16. Table C24 (located in appendix C), provides a transcript of the generalization sessions with Brown’s stages of development (Owens, 2016).

Word categories showed predominantly use of nouns and verbs as seen in Figure 19. He maintained the types of words he used but did not integrate varied tenses of verbs. It is difficult to tell if the shorter utterances with simple words are the result of the language skills not being maintained or rather the need to re-establish the routines and structure of the literacy session since it had been five weeks since he had participated. Cameron required extensive routine and consistency to demonstrate skills. Additional data would need to be collected to determine the relevance of this information.

Figure 19

Cameron: Total frequency of word use across categories in generalization probes.



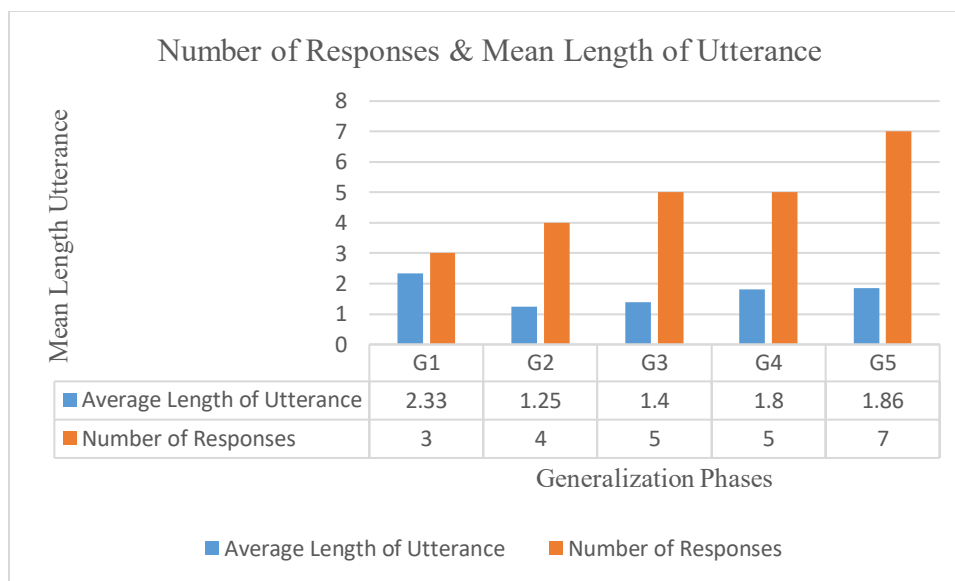
Note: G represents generalization phase; numbers indicate specific phase.

The generalization sessions produced responses that were simpler and had a lower MLU. Most were 1-2 words in length with a standard deviation of .425 and falling within Brown's stages I-III (Owens, 2016). The overall average MLU fell at 1.73. Only familiar texts from the intervention portion of the study were used. Cameron continued to ask for help independently and indicated he was all done on his own in response to the final question. There was a weak negative correlation of $-.183$ between the MLU and the number of responses. Given the weak positive correlation found during the intervention portion of the study no relationship can be determined between these two variables. The standard deviation for number of responses is 1.48 indicating that although one-word responses were common, 3-4 word utterances were present and included familiar content

from the intervention phases. The overall average number of responses was at 4.8. Figure 20 provides an overview of the MLU and number of responses per generalization probe.

Figure 20

Cameron: Total number of responses per generalization probe and mean length of utterance.



Note: G represents generalization phase; numbers indicate specific phase.

In summary, Cameron saw sustained gains in the area of self-determination through increased skills in the area of communicative functions. He maintained gains in how he requests help through the use of his device as well as making relevant comments on texts and indicating appropriate he is all done. Another area of improvement can be seen in the collaborative effort he participates in with the interventionist when searching for a specific word. Learning how to use the ICON Tutor supports self-determination and personal ownership of his SGD.

Inter-Rater Agreement

Four videos were taken of Cameron and his interventionist on 5/2/16, 5/31/16, 6/14/16 and 7/27/16. The inter-rater agreement was .95 with individual session at; .93, .95, .96 and .95. Cameron's interventionist provided a consistent literacy session and detailed data recording. Each video was reviewed with the speech and language pathologist. Consistent agreement was found across all four videos. Data were clear, comments were specific to the prompting and questions asked. The interventionist implemented the student's behavior support plan during the sessions and provided ample wait time for independent responses.

Individual Student Results: Ruth

Ruth began participation in the study on 4/8/16, which ran through 6/17/16. Generalization data occurred between the dates of 7/5/16 through 7/12/16, which were three weeks after the last session. Table 25 displays the randomized phases cycles and the targeted words for removal of the picture icon leaving just the printed word. At the final intervention phase a total of 32 print words were available to the student.

Table 25

Ruth's randomized cycle with phase dates and words targeted for intervention

(print only) including core words (high frequency) which are highlighted in yellow.

CYCLE	PHASE	DATES	NUMBER OF SESSIONS	PRINT WORDS/TREATMENT PHASE
A	1	4/8-4/26	7	
B	2	4/27-5/2	5	I, want(ed), goldfish, not
B	3	5/3-5/10	5	Funny, tired, and, play, feel
B	4	5/11-5/19	5	Happy, monkey, on, toy
A	5	5/24-5/26	5	

CYCLE	PHASE	DATES	NUMBER OF SESSIONS	PRINT WORDS/TREATMENT PHASE
B	6	5/26-6/2	5	Walk(s)(ed), a, hungry, dog (2 places), she
B	7	6/2-6/7	5	Hard(er), work(ed), cat, went, see
B	8	6/7-6/9	5	ate, with, wet, pet
A	9	6/10-6/14	5	
A	10	6/14-6/17	5	

Impact on Language

Ruth chose one of her highly preferred texts to begin the study with. Only familiar texts were used. She had the ability to choose from familiar texts that were available. Core words were targeted as well as content specific words related to the text chosen. Words changed as the text changed so phrases including the words like “goldfish”, “monkey” and “dog” were selected only when the matching text was being used. This is a reflection on the rotation of the text versus Ruth’s ability to recognize and use the print word. Table 26 shows the frequency of the print words used during the intervention phases.

The words that are used more often were directly related to the main character of each text and the words needed to construct basic sentences with these words. The main high frequency print words were;

- “want (ed)”
- “goldfish” (associated with text)
- “monkey” (associated with text)
- “walk (s) (ed)”
- “a”
- “hard (er)”

- “dog” (associated with text)
- “she”
- “word (ed)”

The significance of the words targeted and used the most frequently during the study can be seen in the varied tenses and endings. Ruth was able to appropriately apply varied forms of the words within a fully formed sentence (refer to Table A27 found in appendix A for complete list of utterances).

Table 26

Ruth: Frequency of targeted words per intervention phase.

WORDS	B1	B2	B3	B4	B5	B6
I	7	6	2	2	2	0
WANT(ED)	6	6	5	6	9	9
GOLDFISH	12	12	0	0	0	0
NOT	0	0	1	0	0	0
FUNNY		0	1	1	0	0
TIRED		3	1	0	0	0
AND		0	0	0	0	0
PLAY		0	0	0	0	0
FEEL		0	0	0	0	0
HAPPY			0	0	0	0
MONKEY			6	3	0	0
ON			0	0	0	0
TOY			1	0	0	0
WALK(S)(ED)				4	4	5
A				3	5	6
HUNGRY				0	1	0
DOG				5	7	10
SHE				8	9	16
HARD(ER)					4	5
WORK(ED)					4	5
CAT					0	0
WENT					0	0
SEE					0	0
ATE						0

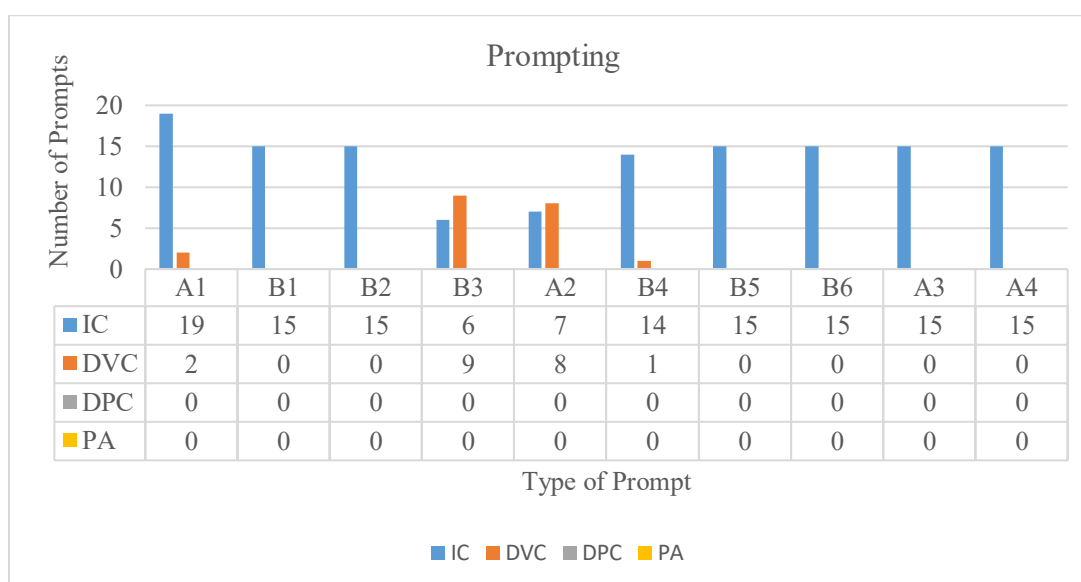
WORDS	B1	B2	B3	B4	B5	B6
WITH						0
WET						0
PET						1

Note: B=intervention phase; Number indicates one of the six intervention phases

In addition, most responses were completed with just an initial cue or rephrasing with great independence clearly depicted in Figure 21 by the fifth intervention phase. This is a significant level of growth when looking at the smaller utterances compared to the more complete full sentences used later on in the study with greater independence. Utterances expanded from simple one-word responses to four words in a complete sentence. By the last four phases (B5-A4) only the initial cue was needed for a total of three prompts per sessions. This was consistent extensive progress in the area of device usage along with expansion of vocabulary and full grammatically correct full sentences.

Figure 21

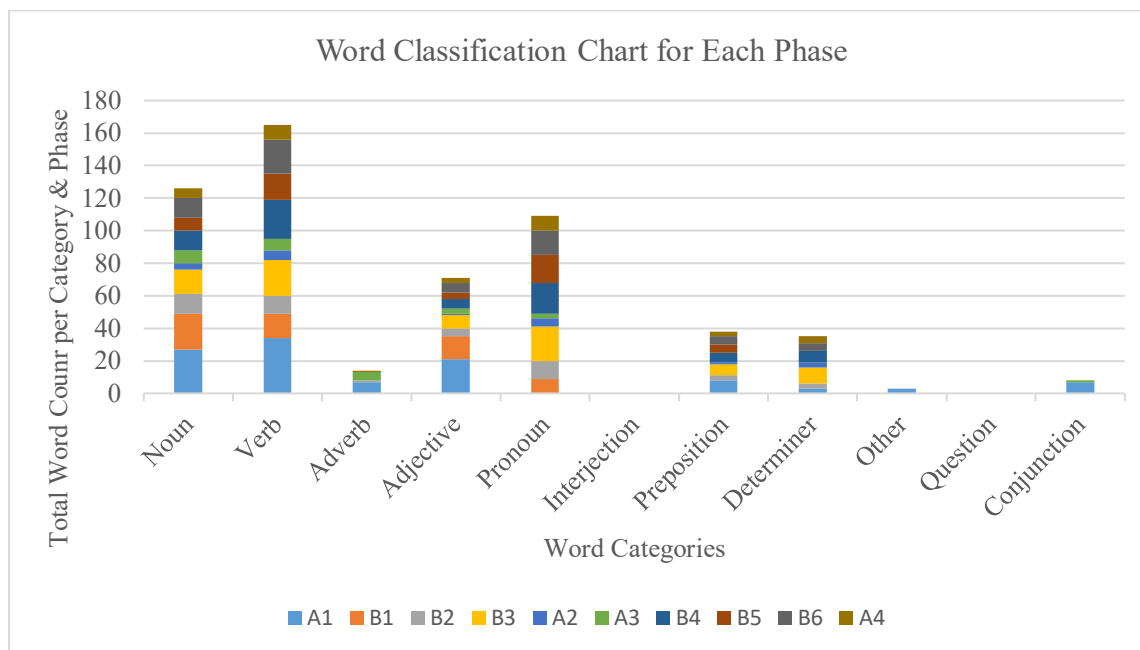
Ruth: Total number of prompts by level for each phase.



Note: IC = Indirect Cue; DVC = Direct Verbal Cue; DPC = Direct Pointer Cue; PA = Physical Assistance: A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

Figure 22

Ruth: Displays the types of words used in each phase as recorded by the language activity monitor and analyzed by Realize Language Software (Prentke Romich Company).



Note: A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

The types of word categories used centered on nouns and verbs with determiners and prepositions added in to connect the sentence (refer to Figure 22). Ruth is a strong sign language user and can understand more signs than she can produce due to the physical aspects of her disability. During the sessions the interventionist used a total communication approach to engage with her and to provide any clarification needed. Words chosen were repetitive in nature but directly related to the questions asked and the content of the text. Slight variations of answers were seen including the use of past tense in how the utterance was constructed. These words were predominantly the ones targeted for intervention as listed previously and were presented in print format only while being

maintained at high levels across the study. This is a consistent area of growth and impact across the study. Her interventionist noted a change in her overall vocabulary throughout the day and in other aspects of her instruction. The interventionists focusing on vocabulary states;

I think well I think overall it's helping her learn vocabulary which will help her more easily communicate. I noticed that we do vocabulary words as well that she's been moving through those more quickly so I think the study helped something click.

The transcript of the responses in Table A27 (located in Appendix A), display over time the growth in utterances and grammatical structure. The other observation from the chart is Ruth's desire to engage in social conversation during the session to talk about her family and what she was doing. Ruth has a very positive relationship with both of the interventionists and will during the day initiate talking about things she has done outside of school. For the purpose of the study she was gently redirected back to the text with recognition of what she wanted to talk about and that this could be done afterwards. Ruth accepted this response.

During this initial sessions rephrasing of the questions was provided. An example of some of the prompting includes;

- Questions 2 asked, What do you think the main character wanted you to know?
 - Rephrased: What do you think the fish wanted you to know?
- Stated question (more than once).

This initial guidance and clarification facilitated better understanding of the expectations of the literacy session. By 4/14/16 she no longer needed rephrasing of the question but

did at times need the question repeated. Ruth presents with both a hearing and vision loss. It is difficult to tell if this impacted the sessions or if this was more of an issue with focus and concentration, which is part of her learning profile.

The range and growth as stated earlier in utterances was remarkable. Some examples from Table A27 include;

- “play” (beginning phases)
- “I want goldfish” (beginning phases)
- “she wanted a dog” (mid study)
- “Hungry monkey” (mid study”
- “She walks to (two) dogs” (Final phases of study)
- “she wanted work hard” (Final phases of study)

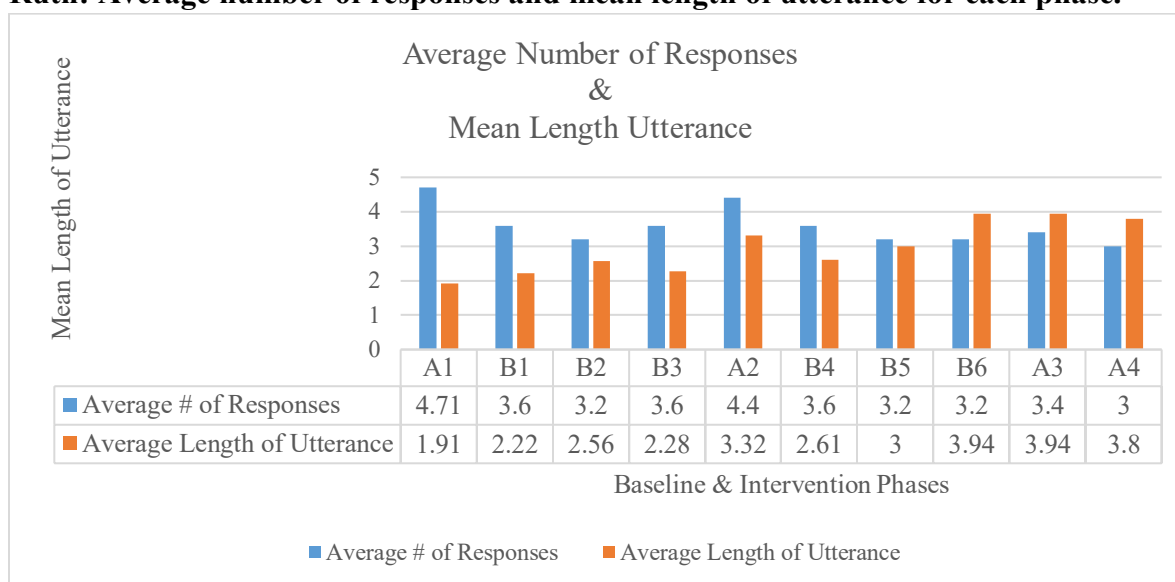
The examples convey the range of utterance formation and growth over time. She explored various endings on a number of words and most often used them appropriately within the context of her utterance. In Table A27, the tilde sign (~) indicates the use of a prompt to support the response.

Figure 23 displays the mean length of utterance (MLU) for each phase along with the average number of responses per phase. There is a weak negative correlation of $-.485$ between the MLU and the number of responses per phase. With the available information and data, no relationship can be assumed between these two variables. There are relatively low standard deviations of the both MLU: $.757$ with an overall mean MLU of 2.96 . The standard deviation for the mean number of responses is $.552$ with an overall average number of responses at 3.59 . The standard deviation indicates that most responses fell at or around the mean with little variation. This demonstrates a certain

level of consistency in responses overall, while the biggest change occurred in the content and the construction of those responses/utterances. Although Ruth's responses ranged from I-Post-V of Brown's stages of development (Owens, 2016), many fell within the higher categories due to advanced use of grammatical and word construction. This is a significant finding for how language was impacted.

Figure 23

Ruth: Average number of responses and mean length of utterance for each phase.



Note: A represents a baseline phase, B represents an intervention phase; numbers indicate the exact baseline or intervention phase.

Impact on Communication

Ruth is a very engaging and social young woman who likes to talk about a variety of things. During the study she was easily engaged in the books she chose and the characters within those books. She consistently looked to the interventionist for approval after each response. Communication functions in general did not expand but they did become more advanced. Table B28 (located in appendix B), provides a summary of her

pre and posttest status. Ruth demonstrated growth in several specific areas of communication function.

Ruth was able to comment on things happening in the recent past as related to her personal life as well as the context of the text read. She added details to her comments that qualify much more articulately what she was trying to say. The interventionist noted this in the interview, “Well learning extra vocabulary being able to do full and complete sentences where before she was just piecing together words and we would interpret what the sentence meant”. This is really where the greatest impact on communication has been and maintained across time.

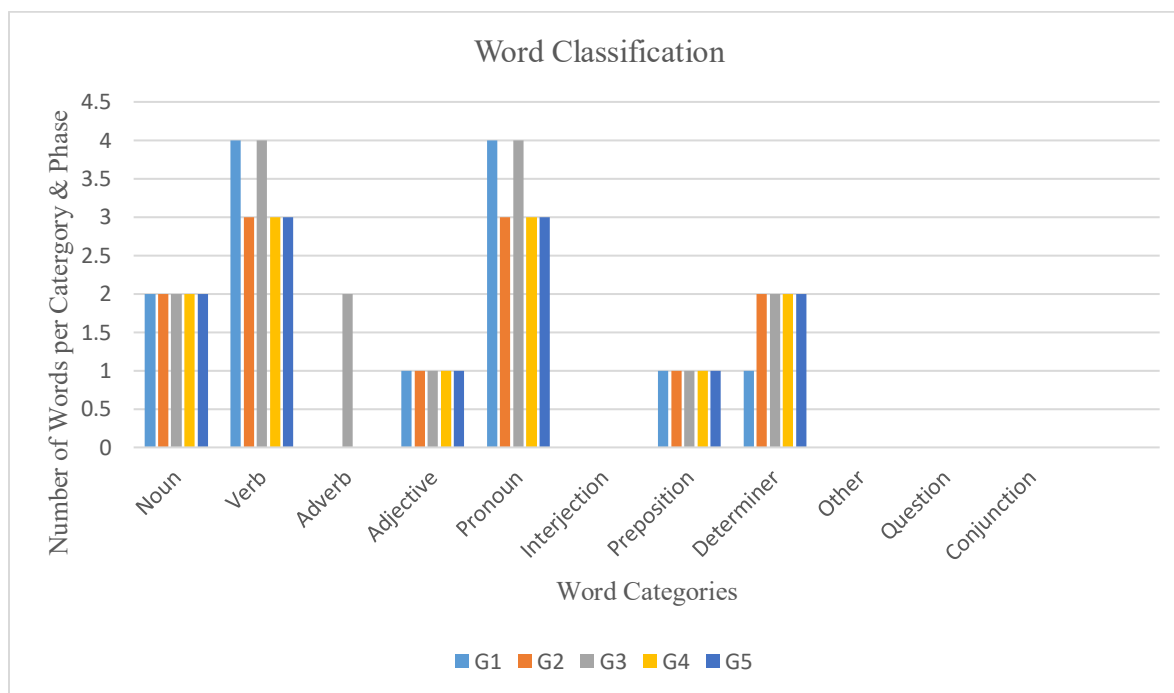
Generalization Phase

The generalization phase occurred over five sessions from 7/5/16 through 7/12/16. This was a little over three weeks from her last literacy session on 6/17/16. During this time school ended and the extended school year began on 7/5/16. Table C29 (located in appendix C), documents the utterances and Brown’s stages over the generalization sessions.

Types of words used are consistent with the implementation phase. Noun and verbs were used with determiners, prepositions and some additional adjectives and adverbs to complete the comment. Figure 24 displays the word category use during the generalization phase.

Figure 24

Ruth: Total frequency of word use across categories in generalization probes.



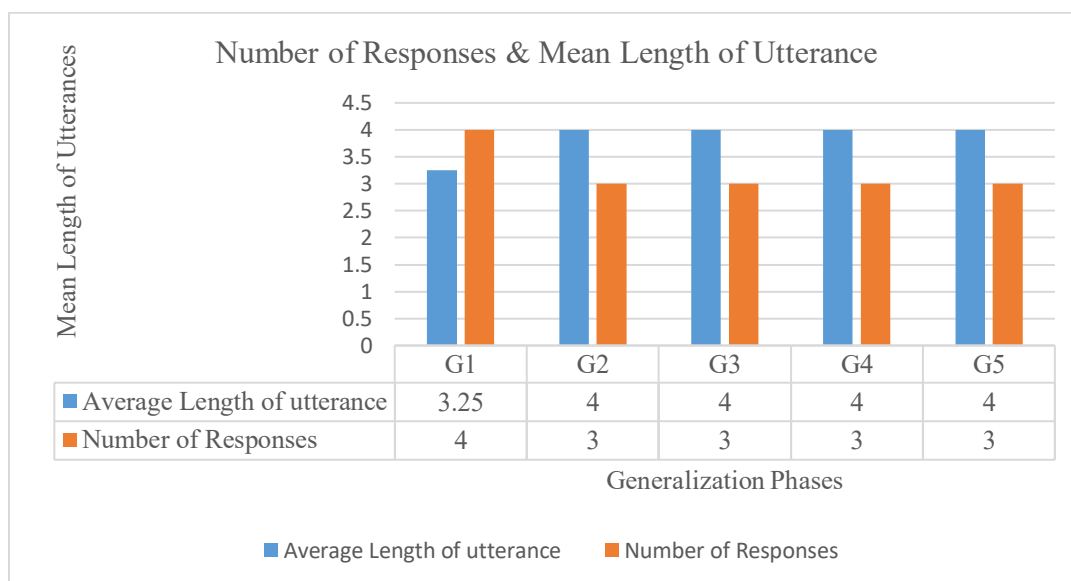
Note: G represents generalization phase; numbers indicate specific phase.

The generalization utterances started off with many of the same structures. She did require a couple of sessions to respond in a manner that was similar to the final phases in the implementation portion of the study. Varied word endings and past tense was not used during the generalization phase. It is possible that Ruth required much more consistency to establish and maintain language skills especially when there was a break between when school ended and when the extended school year began. This is something that should be explored in the future. The number of responses per session were consistent across all five generalization phases as indicated in Figure 25. There was a weak negative correlation between number of responses and MLU of -1.0. Since a weak correlation was found in the implementation portion of the study as well, no relationship

can be determined between these two variables without further investigation over a longer period of time. As in the implementation portion of the study, the standard deviations of the MLU and number of responses remain very small at .335 and .447 respectfully. The average MLU was very stable at 3.85 as well as the average number of responses at 3.2.

Figure 25

Ruth: Total number of responses per generalization probe and mean length of utterance.



Note: G represents generalization phase; numbers indicate specific phase.

Inter-Rater Agreement

Inter-rater videos were taken on; 5/2/16, 6/6/16, 6/15/16, and 7/11/16. Average level of agreement was .95 with individual sessions at; .91, .96, .96 and .95. Although Ruth was aware of the videotaping, she focused on her work during the sessions. All four videos showed meticulous attention to detail and a high level of consistency. The speech and language pathologist and the researcher were in complete agreement with the data

recording for all four videos with very high levels of agreement with the interventionist(s). This high degree of agreement may be the result of the additional effort put in by the two interventionists in the room. Each interventionist observed the other to provide ongoing feedback to ensure that the sessions were structured the same across sessions. This level of agreement may or may not have impacted the significant progress the student made over the course of the study.

Summary of Student Participant Outcomes & Interventionist Perceptions

This research study sought to look at what if any impact the LAMP method may have had on language and communication across a variety of variables analyzed under each student participant. The LAMP method impacted language and communication across all student participants to varying degrees. This was seen across increased skill development in navigation of their SGD, as well as the type of vocabulary selected. In addition, communication functions were expanded, and in some cases, there was a significant increase in the complexity of word usage across people and settings. There were no significant findings in the relationships between length of utterances and number of responses across phases. All students made gains in the use of print words at varying degrees. These gains were sustained in the generalization phase. Finally, some students did struggle with attending and responding during the 1:1 literacy sessions. Behavioral supports plans were followed and positive reinforcement and feedback were given. It is difficult to tell what level of impact this may have had in the overall results for some students.

Summary Impact on Language

All five students demonstrated changes in their vocabulary, complexity of their utterances, as well as how they used more advanced words, word parts and linguistic categories. Each student brought with them different strengths and varied instructional levels. Regardless of where they began, progress was demonstrated. Naquib, Bruck & Costley (2015) discussed the increase in vocabulary and MLU as a result of the LAMP method as well as finding speech use by children increased during the study (p.16). This is consistent with some of the findings of this research. Although MLU remained consistent and stable with some outliers across the student participants, the quality of the utterance improved as indicated by the change in vocabulary and use of word ending, future, past and present tense as well as possession and propositions.

The use of endings, varied tenses and unique word combinations found in each student's transcript demonstrates the need to have such word parts available to students to explore. In a very short period of time, the student participants explored and learned how to apply some of these variations in appropriate ways. Phonetic instruction, access to phonics on the SGD and word parts are critical in literacy and language development including decoding skills and vocabulary expansion (Ahlgrim-Deizell, Browder, Wood, Stanger, Preston, and Kemp-Inman, 2016; Wilkin & Ratajczak, 2009). Some of the word orders were consistent with spoken language and others were not although the communicative intent was still easily understood. Smith (2016) discusses the possibility that, "graphic-based communication systems may bias children towards alternative organizational structures..." (p.219). How the systems are constructed can change how the tense is chosen on the system. Trudeau, Sutton, Morford, Côté-Giroux, Pauzé &

Valeé (2010) discuss the challenge of word order in their study on graphic-symbol sequences. Strategies which support word order associated with speech production should be used in AAC systems (p.309). LAMP attempts to provide some of this structure given the layout and availability of word parts as well as through the use of motor memory. The LAMP method directly links motor memory to speech motor memory and planning (Potts & Satterfield, 2013).

In the LAMP method, the written and spoken word order is supported in most cases. That is, you do not have to select the tense first and then the verb. Vocabulary used during the study was not always directly taught during previous sessions or other instructional activities and included many of the core or high frequency words. Naquib, Bruck & Costley (2015) found similar results which suggest that, “there was an improvement in the use of functional core words after using the LAMP program.....all of the children were independently communicating and were not restricted to vocabulary that had been taught to them” (p.19).

Vocabulary expansion improves access to advanced language and literacy. All students were able to have choice in the books read during the literacy sessions. Wilkins & Ratajczak (2009) point out choice as a factor in their study on literacy skills using SGDs. Their study suggested that choice expands vocabulary use and acquisition both in the text they read as well as the vocabulary programmed into the device. Sam, who was the most advanced communicator, has been reported by his speech and language pathologist and interventionist to have requested specific words to be placed on his SGD. He also had the largest range in text selections, showing clear preference to specific topics as noted in his data analysis section.

The number of utterances and the MLU became very consistent towards the end of the study for all of the students. The vocabulary and utterance construction was very repetitive for four of the five students. Sam had greater variations in content but also had greater variations in the text chosen. Edmister & Wegner (2016) found similar patterns when looking at turn-taking and AAC. Their study suggests that, “the downward trend toward a flat or steady trend line for the number of turns may be a natural consequence after becoming familiar with the vocabulary and routine, when extended to six repeated readings” (p.332). For the four students this was seen in, texts were repetitive throughout the study. Although this led to greater word exploration, it did reduce the number of responses with some outliers.

All student participants developed increased strategic ability to engage with their SGD across multiple boards. In the beginning stages prompting was often needed across four of the five participants with the exception of Sam who had greater SGD experience coming into the study. The LAMP method promotes consistent motor planning actions to locate vocabulary. Icons remain in the same location as more vocabulary is accessed. Consistent motor planning places less demands on working memory, which may assist the student in conveying more immediate and potentially more advanced comments.

Summary Impact on Communication

Communication and communication functions were impacted for all five student participants. As mentioned throughout this chapter, self-advocacy and self-determination skills saw the greatest impact. All students became much more proactive in requesting help during the sessions as well as across other activities throughout the day as reported by their interventionist. For Brenden this resulted in fewer displays of frustration and

greater initiation for assistance independently. Brenden in particular expanded this to how he was feeling and was able to explain his feelings or illness with greater accuracy to staff. In addition, he began to vocalize more across all sessions and throughout the day. These vocalizations and word approximations were used in addition to making selections on his SGD and were presented throughout the day. As discussed previously in Brenden's results section, the use of SGDs may support increased vocalizations and word approximations. Binger (2016) finds "...AAC intervention programs can yield very positive outcomes for aided AAC use without compromising other communication modes and may have a positive impact on speech for some children" (p.110). Brenden was prompted to use his device even when he attempted a verbal approximation of the word. At times he did not want to repeat on his SGD what he may have considered a functional communicative act he had already effectively conveyed. Sigafoos, Didden & O'Reilly (2003) found similar results in students who used single message SGDs and produced vocalizations. They hypothesized that the student may have viewed activating the SGD as redundant. This is an area that requires additional research to better understand how to support students who may vary the preferred form of communication even if this new form may not be as easily as understood by both familiar and unfamiliar communication partners.

Holly saw additional gains in her ability to seek others out independently by calling their name and making a much more specific request. Comments included more details in the literacy sessions with increased skills in how she was able to move between her boards. Social skills were demonstrated in morning circle based on the interventionist's feedback. She will now initiate interactions with peers and responds to

theirs independently. According to Light & McNaughton (2015), “Too often, however, interventions focus on teaching requests for favorite foods or activities to the neglect of teaching skills to promote social interaction and information exchange.” (p.89). The LAMP method supported Holly’s strategic abilities in navigating her SGD so that she was able to engage more naturally and independently, at times of her choosing. This impact carried across environments and through the generalization phase. This is consistent with the study conducted by Naquib, Winchester, Simmons, Robertson & Costley (2013) using LAMP. They documented increases in both play and social communication skills (p.26).

All students expanded their ability to comment and convey information accurately based on a text. Utterances were focused with additional information provided such as interpreting feelings from the story’s main character (Brenden), evaluating the effort of the main character (Ruth – “she worked hard...harder) and making associations with their own personal interests or characteristics (Sam – “he likes pop likes pop like I do”). As mentioned earlier Brenden expanded his comments on feelings across settings and integrated this into how he was able to communicate with staff about what may be upsetting him. These skills positively impacted each students’ ability to engage in more meaningful ways with others and in content instruction.

Summary of Interventionist Perceptions

The interventionists perceived the study as successful for the student participants. They were accurate in reporting the type of progress made, especially when noting the increased accuracy in how words were used and the construction of utterances. In the area of communication functions, all interventionists noted greater independence

especially in the area of self-determination. Student participants were able to request help more effectively, express their feelings and clarify their needs so that the communication partner could respond in a manner that supported their request or comment. Midtlin, Næss, Tøxt and Karlsen (2015), found that children who used AAC expressed vexation when their message was misunderstood or that their form of expression was an attempt at communication.

Finally, the importance of collaboration was identified by all interventionists as the key factor in making the study a success and supporting the student participants in making progress. Each cited ways they sought out additional training and input to support the student through consistency in implementation. Increasing communication partner competencies is a critical component in how we support AAC users. Shire and Jones (2015), point out the lack of research in the area of training for communication partners. How well a communication partner knows an AAC user's system can play a role in the student's overall success. This is an area which must be explored through future research which encompasses more than a single AAC method.

CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

The effective use of augmentative and alternative communication, specifically advanced speech generating devices (SGD) are critical to the inclusion and full participation of those who may not be able to use speech efficiently or effectively. This makes the limited research on specific advanced speech generating devices, communication software, as well as AAC user preference (Midtlin, Næss, Tæxt and Karlsen, 2015) problematic. As stated in Chapter 1, the ability to communicate and engage in the world is a matter of social justice. This study looked at the impact of LAMP method (developed by John Halloran, MS, CCC-SLP, Cindy Halloran, OTR/L and Mia Emerson, M.S., CCC-SLP), using a specific symbol display capitalizing on motor memory to enhance literacy and communication during structured 1:1 literacy sessions. It looked explicitly at the impact the method had on language and communication development using advanced speech generating devices and the planned introduction of print only words (no picture image) for specific vocabulary. The Unity© language system software (Prentke Romich Company) on each student participant's SGD provided the consistent visual and motor based display, as well as extensive vocabulary, word parts and the ability to adjust the display grid size based on student needs. The symbol display, which is at the core of the LAMP method, played a strong role in this research.

Symbol displays are often highly individualized and combined with preprogrammed communications boards developed by various software companies while integrating several different display structures challenging AAC users in a variety of

ways (Drager, Light, Speltz, Fallon & Jeffries, 2003; Light, Drager, McCarthy, Mellott, Millar, Parrish, Parsons, Rhoads, Ward & Welliver, 2004; Thistle & Wilkinson, 2015; Wagner & Jackson, 2006). The challenges must be addressed through providing AAC users with predictable displays so that each selection for a specific word requires the exact same motor movement, reduces operational demands that draw upon working memory, attention to multiple details, and the physical action of making a selection (Caron, Light & Drager, 2016; Drager, Light, Carlson, D'Dilva, Larsson, Pitkin & Stopper, 2004; Drager et al., 2003; Light, Drager, McCarthy, Mellott, Millar, Parrish, & Welliver, 2004; Tan, Zhao, Tian, Cui, Yang, Pan, Zhao & Chen, 2015; Thistle & Wilkinson, 2013; Wagner & Jackson, 2006). The LAMP method addresses many of these concerns through the use of consistent motor planning in each symbol selection and utterance sequence. (Naquib, Bruck & Costley, 2015; Potts and Satterfield, 2013; Halloran & Halloran, 2006). The study found that there were direct benefits of increased print vocabulary, expansion on the accuracy and structure of utterances and increased self-advocacy to varying degrees for each student in the areas of language and communication.

Finally, this study sought to understand interventionist's perceptions of the LAMP method as well as their training, collaboration and overall thoughts on how language and communication might have been impacted. Each interventionist cited specific changes in language and communication. Communication skills were perceived as having the most significant outcome overall across all student participants (Bruce, Trief & Cascella, 2011; Carter & Iacono, 2002; Dada & Alant, 2002; Johnston, Nelson, Evans and Palazolo, 2003; Stoner, Angell and Bailey, 2010). Vocabulary refinement was the second area

mentioned. Each interventionist discussed the refinement of vocabulary usage of those words they used most frequently, and in some cases expanded upon endings and tenses to form more complex utterances (Ahigrim-Deizell, Browder, Wood, Stanger, Preston & Kemp-Inman, 2016; Edmister & Wagner, 2015). The third area cited by the interventionists addressed their experience, training and collaboration as an important component that supported better student outcomes (Chung & Stoner, 2016; Finke, McNaughton and Drager, 2009; Kent-Walsh & Light, 2003; Soto, Maier, Müller and Goetz, 2001a; Soto, Müller, Hunt and Goetz, 2001b).

Implications for Language Development

The study looked in greater detail at the core words which have been identified as the most frequent words used to construct utterances (Beukelman & Mirenda, 2013; Snoggrass, Stoner & Angell, 2013; Van Tatenhove, G., 2014). Specific core words were targeted for print only displays on a particular student participant's SGD. Each student made gains in the selection of the print only version of these words. Although these gains were moderate, the impact on future outcomes may be more substantial (Robinson & Soto, 2013; Van Tatenhove, G. 2014). Vocabulary expansion is a critical element in providing access to information as well as the ability to share information in a manner that reflects the individual, their culture and their age. Systematic exposure to print, words and word parts are key in developing the language skills of students with more complex disabilities (Sturm, J. M., Spadorcia, S. A., Cunningham, J. W., Cali, K. S., Staples, A., Erickson, K. & Koppenhaver, D. A., 2006; Van Tatenhove, G., 2014). The Unity© language software (Prentke Romich Company) using the LAMP method provides such access in a stable and consistent manner for children and adults. We cannot expect

students with complex disabilities to gain skills needed to be in a literate world without giving them the necessary vocabulary to do so. This requires teams to develop a predetermined plan as to how they will continually expand and explore new words both as picture symbols, and as print words. This study proposes that when provided with the necessary structures and vocabulary, even the newest student to the LAMP method has the potential to make immediate gains in print vocabulary understanding as they learn to navigate their device. This was most explicitly seen in the progress made by Holly.

The second impact this study saw was in the area of refined utterances and word use. Two of the three questions asked of each student during the 1:1 literacy sessions were open ended (refer to appendix D). During many of the initial phases, these required an indirect cue for rephrasing. Over time, student participants were able to answer these open-ended questions with relevant utterances including;

- Identifying or inferring feelings character in the story may be experiencing
- Identifying similarities between the story and themselves
- Engaging in humor

The final question during the 1:1 literacy sessions sought to see if students desired to expand on anything else in the book. All the students were able to independently say “no” or “all done” from the first baseline session. Providing this choice in answer allowed each student the opportunity to exercise their self-advocacy and self-determination.

When given the opportunity to engage in open ended questions with no additional visual support other than the book chosen and the SGD, the students could use their memory, inferential skills, and associative powers to engage with and synthesize information in new ways. Utterances in some cases were presented in complete sentences

with expanded word endings, varied tenses and appropriate adjectives and adverbs. Students were allowed to pick their text for each 1:1 literacy session and in some cases, this led to multiple readings of the same book. This repetition and practice in story reading had some degree of impact on the results and the expansion of language overall and should be considered in daily literacy instructional practices (Beukelman & Mirenda, 2013; Downing, Hanreddy & Pecjham-Hardin, 2015; Edmister & Wegner, 2015; Robinson & Soto, 2013; Wilkins & Ratajczak, 2009).

Implications for Communication Development

All students made progress in the expansion of communication functions during the 1:1 literacy sessions as well as generalizing these skills in their classroom as reported by the interventionists. Operational competencies as discussed in the beginning of this chapter, play a strong role in communicative functions and competencies. The study reinforced the concept that intervention must look more at communication access and participation as noted by Teachman & Gibson (2014). Communication access and participation were supported by a system which minimized the competing interests associated with operating an SGD with complex vocabulary (Wagner & Jackson, 2006; Thistle & Wilkinson, 2013). In addition, consistent modeling provided opportunities for student participants to learn how to self-advocate and use those skills immediately within the session (Binger & Light, 2007; Dada & Alant, 2009; Sennot, Light & McNaughton, 2016).

The independent ability to request assistance during the 1:1 literacy sessions and in the classroom at other times was impactful for all student participants. Some began to

speak the word “help” as well as selecting the appropriate symbol while others used vocalizations and/or facial expressions for confirmation after selecting the “help” symbol. This type of self-advocacy can be very powerful and was considered an unanticipated outcome of the study (Hamm & Mirenda, 2006). Self-advocacy skills provide control and the ability to direct one’s care for those with more complex disabilities. This is essential for full participation and access (Light & McNaughton, 2014; Williams, Krezman & McNaughton, 2008). This includes the ability to express emotion, feelings and perspective.

The ability to express emotion, understand and interpret another person’s emotions was demonstrated by one of the students. The ability to use an AAC SGD to convey these complex thoughts and perspectives must be a part of the vocabulary planning as well as the overall supports to have access to this expressive content (Na, Wilkinsin, Karney, Blackstone & Stifter, 2016). One student participant, Brenden, was able to express his feelings to his staff in the classroom more effectively and with increasing independence. It included the ability to use his SGD to indicate that he was not feeling well. This was an unanticipated outcome of this study as it had not focused on the expression of feelings. For this student, feelings were relevant to the book choices he made each week.

Increased social skills were seen in one of the student participants. Holly demonstrated self-initiated social interactions using her SGD to engage with her staff and peers. Holly was observed by the interventionist initiating peer interactions, using her device to call to specific staff by name from across the room, and answering her peers or staff when greeted. Self-initiated interactions are at the core of self-determination. Light

& McNaughton (2014), discuss the importance of social competence and broader communicative functions for AAC users. Expanding upon these communicative functions facilitates greater resiliency as well as access in daily interactions and the ability to expand upon the types of utterances produced by AAC users (King & Fahsl, 2012; Therrien, Light & Pope, 2016; Teachman & Gibson, 2014).

Role of Trained Communication Partners

Professional staff, families and peers play a significant role as communication partners. This study looked at the perspectives of the interventionists around training and collaboration. The interventionists cited the positive influence of additional training, collaboration with the speech and language pathologists and the additional information they sought out as key in supporting better student outcomes (Binger, Kent-Walsh, Ewing & Taylor, 2010; Chung & Stoner, 2016; Douglas, Light and McNaughton, 2012; Howlin, Gordon, Wade and Charman, 2007; Shire & Jones, 2015). Explicit training, team collaboration and ongoing feedback is essential in the consistent implementation of AAC services (Hunt, Soto, Maier, Muller, & Goetz, 2002). In this study, the generalization of skills was noted by each of the interventionists citing both the LAMP method and the consistency in how supports implementation playing a strong role. Naquib, Bruck and Costley, 2015; Halloran & Hollaran, 2006; Potts & Scatterfield, 2013). It is important to note that this generalization occurred in a familiar context with familiar people and peers. Longitudinal research beyond the scope of this study's generalization period is needed to address this formally.

The second key element which should be recognized, is the ability of the communication partner to identify and distinguish various communicative acts.

Communicative acts and the response to them are essential in the development of communication skills which will lead to better long term outcomes. In order for this to occur, the communication partners must be able to distinguish what a communicative act is and how to facilitate the expansion (Carter & Iacono, 2002; Keen, Woodyatt & Sigafoos, 2002; Iacono, Trembath & Erickson, 2016; Teachman & Gibson, 2014). It is important to note that the Functional Communication Profile-R (Klieman, L. L., 2003), was used to identify communication functions pre and post intervention during the study. This tool provided the structure to identify new or changes in current communication functions demonstrated by the student. The interventionists were able to specifically describe communicative acts that led to specific interpretations of how communication functions may have been impacted both in the 1:1 literacy sessions and at other times during the day (Bunning, Smith, Kennedy and Greenham, 2013; Hartmann and Wilkins, 2006; Naraian, 2013).

The third element reinforces the impact of the communication partner modeling vocabulary selection, utterance formation and word finding on the SGD. Each interventionist cited improvement in their ability to use the student's SGD, model and find specific vocabulary. This finding validating previous research in communication partner modeling (Beukelman & Mirenda, 2013; Binger & Light, 2007; Downing, Hanreddy & Pecjham-Hardin, 2015; Edmister & Wegner, 2015; Robinson & Soto, 2013; Sennott, Light & McNaughton, 2016; Wilkins & Ratajczak, 2009). Communication partners demonstrate value in alternative forms of communication when they can freely and intuitively engage with and use the same language system (specific communication software) and corresponding SGD with the students they support. This skill is a critical

factor in promoting better language and communication outcomes. The interventionist learning process was supported by the predictable motor planning used in the LAMP method. This orientation to vocabulary selection and sequencing supported adult motor memory and improved their engagement with the student using the SGD.

Implications for Future Research

Future research is needed in the systematic removal of picture symbols from SGDs, as well as visual supports provided to students with more complex disabilities. Picture symbols have proven to be an effective language support for locutionary communicators who are able to engage with more abstract symbols in a variety of ways (Johnston, Reichle, Feeley and Jones, 2012; Ogletree, Bruce, Finch, Fahey and McLean, 2011). This study suggests some students with more complex disabilities using an advanced speech generating device and a predictable symbol display supporting consistent motor movements for utterance selection, can and do use print words to create novel utterances in meaningful contextually relevant ways. The planned and systematic removal of frequently used picture symbols from SGDs must be considered as a part of our instructional practice with greater use of print only on communication displays.

It may be helpful to look at greater depth into the relationship between the development of vocabulary in typically developing children who use spoken language and those who predominantly use AAC. Zhang and Lu (2014), looked specifically at vocabulary breadth knowledge growth and vocabulary fluency. More specifically, they found a greater impact on vocabulary when it was tied to a specific context versus overall word frequency. For the student participants in this study, the greatest impact was seen in the use of current vocabulary in an increasingly meaningful manner and through the

creation of more complex utterances. This included word manipulation through the application of tenses, ending, possession and contractions. Investigating vocabulary development of AAC users as it compares to typical development may provide valuable information which can be applied to practice.

Mean length of utterance (MLU), numbers of utterances, and utterance efficiency is another area requiring much more attention Trudeau, Sutton, Morford, Côté-Giroux, Pauze & Valee (2010). This study did not find any relevant increase in number of utterances or the mean length of utterance across phases. Utterance quality was impacted using on the average, the same word length. The impact on the AAC user of producing longer and more frequent utterances requires ongoing research. That is, there may be an operational factor that must be addressed. Operational competency, reduction of memory and attending demands are all confounding factors in the search for a more effective system (Caron, Light & Drager, 2016; Drager, Light, Carlson, D'Dilva, Larsson, Pitkin & Stopper, 2004; Drager et al., 2003; Johnston, Reichle, Feeley & Jones, 2012; Hoag, Bedrosian, McCoy, & Johnson, 2004; Light, Drager, McCarthy, Mellott, Millar, Parrish, & Welliver, 2004; Tan, Zhao, Tian, Cui, Yang, Pan, Zhao & Chen, 2015; Thistle & Wilkinson, 2013; Wagner & Jackson, 2006).

Future research should consider the relationship between the operational demands of the LAMP method as well as other AAC device vocabulary displays and what we know about the fractionation of working memory. Baddeley (1996), discusses both the phonological loop and visuo-spatial sketch pad. The phonological loop emphasizes the role temporary storage plays in retaining spoken language and the ability to recall such information when needed. Exploring the relationship between this theory of working

memory as it relates to SGDs which use voice output, auditory signals for vocabulary selection and the ability to convey completed thoughts (one or more words) through digital speech could assist in finding ways to better manage the operational demands of these more complex devices with advanced linguistic abilities.

The visuo-spatial sketch pad (Baddeley, 1996), explores how we use imagery as well as spatial information. The LAMP method is based on picture based symbols displayed in a consistent manner to produce the same motor movements each time a picture symbol or series of symbols representing words and categories are chosen. Exploring how AAC users retain picture symbols and use spatial memory could provide additional knowledge to inform our decisions regarding picture symbol based communication systems and the way in which they are organized. It may also assist in gaining a more in-depth understanding of how and why the LAMP method may work for some individuals and not for others.

Lastly, this study reinforced the need for ongoing training and professional development for communication partners (Binger, Kent-Walsh, Ewing & Taylor, 2010; Beukelman, Hanson, Hiatt, Fager & Bilyeu, 2005; Douglas, Light and McNaughton, 2012; Foreman, Arthur-Kelly & Pascoe, 2007; Norburn, Levin, Morgan & Harding, 2016; Shire & Jones, 2015; Wilder, Agnusson & Hanson, 2015). Greater focus should be placed on building communication partner competencies with each individual AAC user's device. Each of the interventionists commented on their increased skill in using the individual AAC user's device as well as other devices used by students in their classrooms. The generalization of skills to devices with varied communication display organization, was an unanticipated outcome of the study and should be considered in

future research. The expansion of communicative functions may have been impacted in part by the shared interaction of the interventionists and the AAC user with their SGD. These functions expanded the student's ability to self-advocate, communicate their feelings and learn to assist in finding new vocabulary in their device.

Limitations

This mixed methods study met the five-participant minimum described in the What Works Clearinghouse (WWC) standards from 2010 and integrated a randomized staggered multiple baseline intervention series. Although meeting this minimum was relevant to the reliability and validity of the study, the sample size remains relatively small. This is in part due to the limited number of students who use the LAMP method, as well as the overall limited AAC users in the general student population. Replication studies and longitudinal studies will be needed to compare results, looking for consistencies and inconsistencies across groups of students using the LAMP method.

This study was not able to describe the impact the additional 1:1 literacy sessions had on each student. That is, how much benefit did each student receive from the additional 1:1 instructional time? This is a potential limitation but also an area which should be addressed by future research. Control groups were not used and should be considered in any additional research in this area. Special consideration would need to be given to the unique learning, access needs and individual AAC user preferences when developing such control groups and the experience levels of the student participants with the SGD, associated language software system and organizational system.

This study used consistent communication partners with no variation. Although this may be helpful in some initial instruction, research needs to consider varied

communication partners or interventionists to look at broader issues of generalization and professional development. This may also inform how language is organized on SGDs to support the AAC user as well as both familiar and unfamiliar communication partners. The prior experience of the student students with the LAMP method varied and may have had an impact on the study. Since each student intervention was compared against their own baseline results, this impact was minimized.

Conclusion

We live in a world that preaches inclusion and equality for all, yet we expect AAC users to engage in this world without the necessary supports, tools and language to make this possible. If expectations are to be raised, then the field of education and technology must act in ways to support this. This study provides some evidence that the LAMP method with a motor memory based language software system such as Unity© (Prentke Romich Company) can build the necessary language and communication skills needed to participate in an accessible present and future life that is driven by self-determination and personal choice. This study made problematic the lack of access to more advanced language supports that may change long term outcomes for students with more complex disabilities. It is an issue of social justice that must be acted upon sooner rather than later. People with complex disabilities who may not have access to effective spoken language do not have time to wait for the field to move forward. Researchers and practitioners have an obligation to act now to make changes. People with more complex disabilities must be included in this leadership, and their voices heard within the research, the practice, and the evolution of AAC.

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Appendix A
Transcript of Utterances and Brown's Stages per Student

Table 7
Brenden
Transcript of utterances and Brown's Stages

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 4 (A)	Game and (and) Barney movie I went.	11	11	Post V
	go playground ~		2	I
	mom girl sister woman.		4	V
	go to~		2	I
	food and (and) school		5	V
	barney.			
	chicken store game work.		4	N/A
	rice turkey.		2	N/A
	Yes.		1	I
	I silly a ~		3	I
	book is silly ~		3	III
	you went play.		3	III
	Little Critter Doll.		3	III
	eat.		1	1
APRIL 4 (A)	pet dog.	6	2	1
	play I a work.		4	V
	yes.		1	1
	pet dog.		2	1

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 5 (A)	little critter doll (little critter doll) play match bowling ~	9	9	Late V
	pool therapy ball sadly.		4	Late V
	yes is boring show watch Backyardigans notebook hurt a Hi!		10	Late V
	What's up?		2	2
	slide slide.		2	1
	play me.		2	2
	yes.		1	1
	obstacle bedroom.		2	N/A
	fast house pancake bagel.		4	N/A
	little critter doll play.	2	4	N/A
APRIL 5 (A)	sadly ~		1	I
	Pet.	7	1	I
APRIL 6 (A)	It.		1	N/A
	hamster little critter doll (little critter doll) pet yes		13	Late V
	computer pet it dog.			
	dog it ~		2	I
	pets ~		1	I
	yes.		1	I
	pet it dog ~		3	III
APRIL 7 (A)	I want hello more (hello hello) the.	10	7	II
	cool.		1	1
	my turn.		2	1

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
	dog ~		1	I
	pet dog it play.		4	V
	feed hungry feed (feed) my		9	Late V
	turn eat (eat eat).			
	shoe soap sandwich.		3	N/A
	they ~		1	I
	yes.		1	I
	excited.		1	I
APRIL 7 (B)	little critter doll (little critter doll).	4	6	I
	rest ~		1	I
	yes.		1	I
	I happy.		2	I
APRIL 8 (B)	he hopes cake.	5	3	III
	cake cupcake (cupcake)		13	III
	little critter doll therapy			
	swing (little critter doll)			
	shopping cart.			
	cake.		1	I
	yes.		1	I
	little critter doll ate cake.		5	Late V
APRIL 8 (B)	notebook story journal little critter doll.	4	6	III
	little critter doll (little critter doll) birthday cake yes.		9	V
	birthday cake.		2	I
	All done.		2	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 12 (B)	map an an (an) therapy.	9	5	N/A
	little critter doll ~		3	I
	therapy swing.		2	I
	elevator.		1	I
	count Sean was our house I		11	Late V
	little critter doll to work.			
	I am allergic to pork beef		8	Late V
	and gelatin.			
	I go to school at SSEC.		6	Late V
	yes.		1	I
APRIL 13 (B)	little critter doll bus.	6	4	I
	little critter doll (little critter		12	I
	doll little critter doll little			
	critter doll).			
	worked.		1	I
	playground to happy.		3	III
	yes.		1	I
	to keep cookie chicken ate		8	III
	tomato does it.			
	eating grapes orange.		3	II
APRIL 14 (B)	notebook little critter doll.	6	4	I
	feeding cake cookie.		3	I
	Joe little critter doll.		4	I
	names book.		2	I
	yes.		1	I
	play.		1	I
APRIL 14 (B)	little critter doll.	5	3	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 26 (B)	breakfast ice cream ~	6	2	I
	little critter doll loves open		9	III
	block (little critter doll).			
	was mad ~		2	II
	yes.		1	I
	little critter doll.		3	I
	elevator.		1	I
	little critter doll kiss ~		4	I
	he likes his (he likes his).		6	II
	yes.		1	I
APRIL 28 (B)	happy a.	4	2	I
	little critter doll.		3	I
	pool.		1	I
	yes (yes).		2	I
	sad der er sadly.		4	II
APRIL 29 (B)	notebook.	9	1	I
	my turn.		2	I
	was.		1	I
	story.		1	I
	to understand will it TV		6	III
	guide.			
	little critter doll.		3	I
	happier.		1	I
	yes (yes).		2	I
	little critter doll (doll)		6	III
MAY 2 (A)	swings sandbox.	4		
	yes book.		2	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 2 (A)	bus.	6	1	I
	before mine.		2	I
	yes story (yes yes yes).		5	I
	yes (yes yes).		3	I
	dog.		1	I
	little critter doll.		3	I
MAY 3 (A)	chicken.	3	1	I
	pet yes ~		2	I
	pet fish.		2	I
	book story.		2	I
	TV guide TV guide cookie		6	II
	(cookie).			
MAY 3 (A)	the end.	3	2	I
	journal story.		2	I
	happier.		1	I
MAY 5 (A)	email not email.	3	3	N/A
	book journal red bird		5	III
	(birds).			
MAY 5 (A)	zoo animals.	3	2	I
	test (test) novel.		3	I
	stairs ~		3	I
	up stairs.		1	I
MAY 9 (A)	Little critter doll.	3	3	I
	sad.		1	I
MAY 10 (A)	bus.	5	1	I
	little critter doll book.		4	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 11 (A)	playground.	5	1	I
	bored.		1	I
	yes TV guide TV guide email.		6	III
	it pet cat.		3	III
	yes.		1	I
	little critter doll.		3	I
	sad hurt scared no.		4	III
	yes (yes yes yes).		4	I
MAY 12 (A)	email TV guide (email).	6	4	II
	little critter doll clothes.		4	II
	scared ~		1	I
	yes TV guide email.		4	II
	you tell one.		3	III
	dining room.		2	I
MAY 13 (B)	I'll feel happy.	6	3	III
	book email.		2	I
	moon.		2	I
	email elephant opening.		3	N/A
	happier magazine.		2	I
	yes (yes).		2	I
	rocket.		1	I
	red (red) boots.		3	I
MAY 17 (B)	yes email.	3	2	I
	pet hamster cat.		3	I
MAY 17 (B)	book email.	5	2	I
	yes cat.		2	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 18 (B)	chicken sings.	4	2	I
	yes.		1	I
	play swing.		2	I
	dog email.		2	I
	cat changes.		2	I
MAY 19 (B)	desert.	6	1	I
	yes dry.		1	I
	email will he cat.		4	III
	piano music.		2	I
	cat feels.		2	I
MAY 24 (B)	cat feels happy.	6	3	III
	yes.		1	I
	Ice cream.		1	I
	book.		1	I
	classmates.		1	I
MAY 24 (B)	Ms Jones.	3	2	I
	woman.		1	I
	yes.		1	I
	green.		1	I
	email.		1	I
MAY 26 (B)	is email.	9	2	I
	to.		1	I
	she loves.		2	I
	video game.		2	I
	bird ~		1	I
	fly ~		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 27 (B)	red bird.	6	2	I
	web it chicken.		3	N/A
	4 red bird home it.		5	Late V
	yes no.		2	I
	red bird it no classmates		6	V
	Dennis.			
	red dog.		2	I
	will it red it dog.		5	V
	fire engine.		2	I
	yes.		1	I
MAY 31 (B)	excuse me book.	6	3	III
	book city were.		3	I
	story email.		2	I
	rain.		1	I
	rain.		1	I
	weather ~		1	I
	yes.		1	I
	rain.		1	I
	notebook email.		2	I
	swing.		1	I
JUNE 1 (B)	foot ~	7	1	I
	yes.		1	I
	magazine.		1	I
	arm.		1	I
	feet.		1	I
	book email.		2	I
	cat.		1	I
JUNE 2 (B)		5		

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 2 (B)	shower ~	7	1	I
	yes.		1	I
	face sick.		1	I
	email (email) yes.		3	I
	email.		1	N/A
	cookie.		1	I
	help body ~		2	I
JUNE 3 (B)	happy feeling nice.	6	3	I
	yes.		1	I
	playground.		1	I
	Yeah go (go go).		4	I
	bathroom.		1	I
	Yes.		1	I
	did she.		2	I
JUNE 6 (B)	bike ~	5	1	I
	mom ~		1	I
	turtle.		1	I
	they're animals ~		2	III
	yes.		1	I
	is she.		2	I
	dingo.		1	I
JUNE 6 (A)	weather.	5	1	I
	cloud.		1	I
	yes.		1	I
	cloud.		1	I
	rain.		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 7 (A)	we will dog pet.	5	4	III
	cat.		1	I
	cat sadder.		2	I
	yes.		1	I
	I like book.		3	III
JUNE 8 (A)	zoo animal.	6	2	I
	bear.		1	I
	moon.		1	I
	yes.		1	I
	email.		1	N/A
	Rocket ~		1	I
JUNE 8 (A)	go ~	4	2	I
	he mad.		1	I
	yes.		1	I
	lion.		1	I
JUNE 9 (A)	book.	7	4	I
	elevator TV guide email.		4	II
	notebook letter TV guide.		1	II
	happy ~		2	I
	a (a) book.		1	I
	yes.		1	I
	book.		1	I
JUNE 10 (B)	email.	5	4	N/A
	notebook change		4	II
	playground his.			
	he help.		2	I
	yes.		2	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 10 (B)	green.	4	1	I
	notebook daffodil tulip ~		3	I
	plant ~		1	I
	yes.		1	I
JUNE 13 (B)	tomato were ~	5	2	I
	book email.		2	I
	weather ~		1	I
	need rain sun wind snow.		5	V
	yes.		1	I
JUNE 13 (B)	rain.	4	1	I
	email.		1	N/A
	food ~		1	1
	Cast food cast ~		3	1
JUNE 17 (B)	no.	6	1	1
	email.		1	N/A
	book.		1	I
	rain.		1	I
	to rain.		2	I
	bad weather ~		2	I
	no.		1	I

Note: The tilde sign (~) indicates the use of a prompt to support the response. Incorrect responses (those that do not connect to the story or the question asked) have been highlighted. In addition, repetitive phrases have been noted with parenthesis.

Table A12**Sam****Transcript of utterances and Brown's Stages**

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 5 (A)	I love the therapy.	5	4	V
	and the rock 2000 4.		5	V
	He likes pop like I do.		6	Post-V
	a smasham he wins a lot.		6	V
	no.		1	I
APRIL 5 (A)	he love to win.	3	4	V
	do loves to win.		4	V
	no no.		2	I
APRIL 6 (A)	I eat.	4	2	I
	singing.		1	I
	he wants not be sad.		5	V
	no.		1	I
APRIL 8 (A)	fight fight.	4	2	I
	to play.		2	I
	they like to win.		4	V
	no.		1	I
APRIL 11 (A)	We are going to make the green.	8	7	Post-V
	you I'm I have an emergency.		6	Post-V
	she's nice.		2	II
	she can win.		3	III
	fight.		1	I
	for that purple.		3	III
	president.		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 12 (A)	no.	9	1	I
	you you hug.		3	II
	I hi 1 5.		4	III
	he want people.		3	III
	you you sad.		3	II
	he made person stuff.		4	V
	he making made.		3	III
	to want people.		3	III
	u mad.		2	II
APRIL 13 (B)	no.	7	1	I
	they come to teach stuff.		5	Post-V
	help.		1	I
	I have an emergency.		4	V
	or I have an emergency.		5	V
	They come to help.		4	V
	they need to think to help people.		7	Post-V
APRIL 14 (B)	no.	6	1	I
	I don't want to go outside.		6	Post-V
	I have to.		3	II
	They they're going.		3	II
	she wants outside.		3	III
	they bad.		2	II
APRIL 25 (B)	no.	11	1	I
	I sees.		2	I
	I saw the movie.		4	V
	friend friendship helps.		3	III

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 26 (B)	I want.	10	1	I
	did it you.		2	II
	she's looking.		2	III
	their's the.		2	III
	I I likes.		2	II
	I thought the movie were was cute.		7	Post-V
	they're saw looking for hers mom.		6	Post-V
	no.		6	Post-V
	very.		1	I
	does she want.		3	III
	worse.		1	II
	think.		1	II
	help.		1	I
	your turn.		2	II
	body help you.		3	III
APRIL 28 (B)	mom win matched.	7	3	III
	not not she's matched lost.		5	V
	no.		1	I
	I am.		2	II
	stop.		1	I
	I forgot to exercise.		4	V
	stop.		1	I
	moon science science sciences.		4	III
APRIL 28 (B)	no they like baseball.	3	4	V
	no I do not want to cook.		7	Post-V
	cheeseburger.		1	II

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
	you they love baseball.		4	V
	no.		1	I
MAY 2 (A)	together together together.	6	3	II
	fight don't do that.		4	V
	not not to date.		4	III
	I make television.		3	III
	care channels.		2	II
	no.		1	I
MAY 3 (A)	she goes make high.	3	4	V
	she likes know high stuff.		5	V
	no.		1	I
MAY 5 (A)	bird.	3	1	I
	they love to together fly.		5	V
	no.		1	I
MAY 8 (A)	same does it feel and same different.	4	7	Post-V
	same body wrong.		3	III
	same different body are good.		5	V
	no.		1	I
MAY 10 (A)	tunnel they're once.	3	3	IV
	help.		1	I
	they want helpful.		3	III
MAY 11 (B)	next start IPOD little.	8	4	V
	he wants.		2	II
	she.		1	I
	I was.		1	II
	I will play baseball.		4	V

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 12 (B)	but buy business.	4	3	III
	I will play sports.		4	V
	no.		1	I
	A lot on bar bad.		5	V
	we like.		2	II
MAY 13 (B)	they like to fly.	4	4	V
	no.		1	I
	food.		1	I
	they're feeds.		2	III
	feed hungry.		2	II
MAY 17 (B)	no.	5	1	I
	He.		1	I
	he wants.		2	II
	he's at schooling.		2	IV
	I he he's learning stuff.		5	V
MAY 17 (B)	no.	8	1	I
	cute birthday bag.		3	III
	atmosphere bad business.		3	IV
	brain.		1	I
	queen.		1	I
MAY 18 (B)	Gali.	5	1	I
	brackish.		1	III
	bar.		1	I
	no.		1	I
	stuff.		1	I
	stuff.		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
	stuff.		1	I
	fight friend fighter.		3	III
	I fire are bad.		4	IV
MAY 19 (B)	cat fight fighting.	4	3	III
	and they are fight fighting.		5	V
	yes.		1	I
	no right.		2	II
MAY 24 (B)	poay.	5	1	I
	dako.		1	I
	dagiiioo.		1	I
	They're letting family.		2	IV
	no.		1	I
MAY 24 (B)	bed robbery been buyers.	2	4	III
	birthday efficacy done.		3	III
MAY 26 (B)	she he she goes high.	3	5	IV
	She likes to go high.		5	Post-V
	no.		1	I
MAY 27 (A)	worst hot weather.	4	3	IV
	they like weather.		3	III
	they like weather.		3	III
	no.		1	I
MAY 31 (A)	going high.	5	2	II
	she she she's is going high.		6	V
	no.		1	I
	she goes high.		3	III
	no.		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 1 (A)	I'm just tired.	4	3	IV
	weather clothing.		2	II
	They like weather.		3	III
	no.		1	I
JUNE 1 (A)	Do you have any pets?	4	5	Post-V
	animal.		1	I
	he loves his mom.		4	V
	no.		1	I
JUNE 2 (A)	road.	3	1	I
	them they help.		3	III
	you drive.		2	II
JUNE 2 (B)	body.	3	1	I
	exercise.		1	I
	he loves to exercise.		4	V
JUNE 6 (B)	feet.	3	1	I
	they know a lot about foot.		6	Post-V
	no.		1	I
JUNE 6 (B)	a b abodes.	9	3	III
	a ball.		2	II
	a d batteries.		3	III
	a a a a.		4	I
	a a a .		3	I
	a a a a .		4	I
	a a a .		3	I
	batteries.		1	I
	no.		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 7 (B)	f.	8	1	I
	f.		1	I
	transportation.		1	I
	taxi.		1	I
	fire engine.		2	II
	river sunrise sunrise.		3	II
	pond sunrise sunrise.		3	II
	no.		1	I
JUNE 7 (B)	They're going to the moon.	3	5	Post-V
	They're going to the moon.		5	Post-V
JUNE 8 (B)	no.	4	1	I
	colors.		1	I
	they're.		1	II
	they love colors.		3	III
JUNE 8 (B)	no.	4	1	I
	weather.		1	I
	weather.		1	I
	read.		1	I
JUNE 9 (B)	they love to rain.	4	4	V
	my they're me.		3	III
	fight awesome.		2	II
	at fight.		2	II
JUNE 9 (B)	no.	3	1	I
	he falls in love.		4	V
	he has to go to with she.		7	Post-V
	no.		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 10 (B)	you didn't say.	5	3	IV
	bad book.		2	II
	he had to go out at night.		7	Post-V
	he was scared.		3	III
	no.		1	I
JUNE 10 (A)	bat.	6	1	I
	battery.		1	I
	a a.		2	I
	hi.		1	I
	they can fix stuff.		4	V
JUNE 13 (A)	no.	3	1	I
	colors.		1	I
	she she's going to paint.		5	V
JUNE 13 (A)	no.	3	1	I
	I eat health healthy diet.		5	V
	maybe he is in on a diet.		7	Post-V
JUNE 14 (A)	no.	4	1	I
	they need thing.		3	III
	Erin they they need things.		5	V
	they want things.		3	III
JUNE 14 (A)	no.	5	1	I
	hitchhiking.		1	I
	dog.		1	I
	he's old.		2	III
	no.		1	I
	no.		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 15 (B)	tree.	4	1	I
	room house.		2	II
	he builds tree house.		4	V
	no.		1	I
JUNE 15 (B)	I know its his last first day.	3	7	Post-V
	I feel he felt nervous.		5	V
	no.		1	I
JUNE 16 (B)	need to.	4	2	II
	they feel he sun needs.		5	V
	he wants stuff.		3	III
	no.		1	I
JUNE 16 (B)	elephant.	3	1	I
	they want a baby.		4	V
	no.		1	I
JUNE 17 (B)	Happy New Year.	4	3	III
	was being mean out in the car.		7	Post-V
	he was fix mean mean.		5	V
	no.		1	I

Note: The tilde sign (~) indicates the use of a prompt to support the response.

Table A17**Holly****Transcript of utterances and Brown's stages.**

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 6 (A)	good.	3	1	I
	all done.		2	II
	good love.		2	II
APRIL 7 (A)	me.	13	1	I
	favorite.		1	I
	vehicle.		9	Post-V
	My name is FeFe and I		4	V
	live in Holbrook.			
	my name is FeFe.		4	V
	my name is FeFe.		4	V
	my name is FeFe.		4	V
	my name is FeFe.		4	V
	about with me.		3	III
	good.		1	I
	does it.		2	II
	yes.		1	I
	shoe~		1	I
APRIL 8 (A)	likes dog cat.	4	3	II
	I ear shoe~		3	II
	asleep		1	I
	no.		1	I
APRIL 11 (A)	blue.	5	1	I
	like.		1	I

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 12 (A)	very good.	4	2	II
	no.		1	I
	ugly.		1	I
	story.		1	I
	books books.		2	I
APRIL 15 (A)	cat~	3	1	I
	no.		1	I
	red.		1	I
APRIL 26 (A)	red shoe red.	8	3	III
	no.		1	I
	How are you?		3	III
	Hi.		1	I
	Hi.		1	I
	shoe.		1	I
	Ms. Irene.		2	I
	shoe white.		2	II
	maybe.		1	I
	no.		1	I
APRIL 27 (B)	Hi.	14	1	I
	jacket.		1	I
	How are you?		3	III
	How are you?		3	III
	How are you?		3	III
	I'm fine.		2	III
	I'm fine.		2	III
	I'm fine.		2	III

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 28 (B)	How are you?	15	3	III
	Hi.		1	I
	shoe~		1	I
	red red.		2	I
	get me.		2	II
	no.		1	I
	cat red.		2	II
	it can no.		3	III
	no no.		2	I
	no.		1	I
	questions.		1	I
	no questions.		2	II
	body no.		2	II
	color no no.		3	II
	radio no yes.		3	II
	upside down to get we.		5	III
	outside.		1	I
	me yes.		2	II
	no no no I.		4	II
	no no no.		3	I
APRIL 29 (B)	kitchens no.	31	2	II
	wait way.		2	I
	clean body.		2	II
	almost.		1	I
	you're going me.		3	IV
	you you I'm going.		4	IV

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
	nearly.		1	I
	bad yes.		2	II
	awake a lot.		3	III
	awake.		1	I
	home home shoe.		3	II
	it.		1	I
	questions.		1	I
	no no maybe.		3	II
	two.		1	I
	say me no.		3	III
	I should.		2	II
	no no no.		3	I
	I can no.		3	III
	sleep.		1	I
	get me small appliance.		4	V
	color no.		2	II
	get kitchens.		2	II
	orange.		1	I
	no bad no.		3	III
	bad.		1	I
	just telephone.		2	II
	red.		1	I
	and somebody all done.		4	V
	us.		1	I
	no.		1	I
	yes.		1	I

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 2 (B)	red.	5	1	I
	I have.		2	II
	I have.		2	II
	cat ~		1	I
	no.		1	I
MAY 3 (B)	I like it.	3	3	III
	cat ~		1	I
	no.		1	I
MAY 4 (B)	red ~	4	1	I
	it cat.		2	II
	body.		1	I
	no.		1	I
MAY 4 (B)	red dog do.	6	3	III
	cat ~		1	I
	no.		1	I
	color could I.		3	III
	me.		1	I
	I.		1	I
MAY 9 (B)	shoe ~	3	1	I
	cat ~		1	I
	no.		1	I
MAY 11 (B)	cat ~	3	1	I
	red ~		1	I
	no.		1	I
MAY 13 (B)	he loves ~	3	2	II
	shoe ~		1	I

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 17 (A)	no.	4	1	I
	look.		1	I
	cat ~		1	I
	glasses ~		1	I
MAY 19 (A)	no.	6	1	I
	cat ~		1	I
	glasses ~		1	I
	no.		1	I
	no.		1	I
	no.		1	I
MAY 23 (A)	no.	3	1	I
	cat.		1	I
	blue ~		1	I
	no.		1	I
MAY 24 (A)	cat.	7	1	I
	watch glasses.		2	II
	maybe.		1	I
	maybe.		1	I
	maybe.		1	I
	maybe.		1	I
	no ~		1	I
	cat.		1	I
MAY 24 (A)	It would.	7	2	II
	purple purple.		2	I
	blue ~		1	I
	it would.		2	II

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 25 (A)	glasses ~	6	1	I
	no.		1	I
	green.		1	I
	blue ~		1	I
	its its cat orange.		4	III
	no.		1	I
MAY 26 (A)	it would.	4	2	II
	wet.		1	I
	glasses ~		1	I
	looking looked.		2	I
	cat.		1	I
MAY 26 (A)	no.	3	1	I
	blue ~		1	I
	cat ~		1	I
MAY 27 (A)	no ~	4	1	I
	cat.		1	I
	dry.		1	I
	glasses ~		1	I
MAY 27 (A)	no.	4	1	I
	cat.		1	I
	cat.		1	I
	blue.		1	I
	no.		1	I
MAY 31 (B)	cat ~	4	1	I
	pig fast.		2	II
	blue.		1	I

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 1 (B)	no ~	9	1	I
	him.		1	I
	chicken.		1	I
	dog.		1	I
	cat~		1	I
	glasses.		1	I
	yes.		1	I
	dog.		1	I
	not.		1	I
JUNE 1 (B)	no.	9	1	I
	pet.		1	I
	cat~		1	I
	no.		1	I
	watch.		1	I
	glasses.		1	I
	purple.		1	I
	no.		1	I
	no.		1	I
JUNE 2 (B)	yes.	7	1	I
	cat.		1	I
	blue ~		1	I
	glasses.		1	I
	no ~		1	I
	yes.		1	I
	dog time.		2	II
	no.		1	I

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 2 (B)	cat ~	4	1	I
	glasses~		1	I
	blue ~		1	I
	no.		1	I
JUNE 3 (B)	cat.	4	1	I
	watch ~		1	I
	glasses ~		1	I
	no.		1	I
JUNE 3 (B)	cat.	4	1	I
	glasses.		1	I
	yes.		1	I
	blue ~		1	I
JUNE 6 (B)	cat.	4	1	I
	glasses.		1	I
	blue ~		1	I
	no.		1	I
JUNE 6 (B)	cat.	4	1	I
	glasses ~		1	I
	blue.		1	I
	no.		1	I
JUNE 7 (B)	cat.	5	1	I
	glasses.		1	I
	blue ~		1	I
	yes.		1	I
	no.		1	I
JUNE 7 (B)	cat ~	9	1	I

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 8 (B)	I have.	7	2	II
	I have.		2	II
	glasses ~		1	I
	I go to school at SSEC.		6	Post-V
	I go to school at SSEC.		6	Post-V
	yes.		1	I
	blue ~		1	I
	no.		1	I
	cat.		1	I
	no.		1	I
	see me.		2	II
	he wants.		2	II
	kid.		1	I
	yes.		1	I
JUNE 8 (B)	cat.	6	1	I
	he will.		2	II
	cat.		1	I
	it did.		2	II
	telephone Ms. Mary.		3	II
	it.		1	I
JUNE 9 (B)	green kid.	3	2	II
	cat.		1	I
	clothing button.		2	II
JUNE 9 (B)	no.	3	1	I
	cat.		1	I
	button ~		1	I

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 10 (B)	no.	3	1	I
	dog.		1	I
	cat.		1	I
	button.		1	I
JUNE 10 (B)	no.	4	1	I
	dog.		1	I
	cat.		1	I
	button.		1	I
JUNE 13 (B)	no.	3	1	I
	cat.		1	I
	button.		1	I
JUNE 13 (B)	no.	3	1	I
	cat.		1	I
	button.		1	I
JUNE 14 (B)	no.	5	1	I
	cat~		1	I
	button.		1	I
	art supplies.		2	II
	four.		1	I
JUNE 14 (A)	no.	8	1	I
	dog		1	I
	dog.		1	I
	animal ~		1	I
	cat.		1	I
	button ~		1	I
	yes.		1	I

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 15 (A)	I know.	3	2	II
	all done.		2	II
	cat.		1	I
	button ~		1	I
JUNE 15 (A)	no.	6	1	I
	cat.		1	I
	button.		1	I
	yes.		1	I
JUNE 16 (A)	4 ~	19	1	I
	4		1	I
	no.		1	I
	need.		1	I
	she.		1	I
	he does.		2	II
	dog.		1	I
	I know me.		3	III
	cat fish.		2	II
	yes.		1	I
	yes.		1	I
	yes.		1	I
	print.		1	I
	me.		1	I
	yes.		1	I
	no no no.		3	I
	no.		1	I
	yes.		1	I

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 16 (A)	no no.	12	2	I
	no.		1	I
	outside.		1	I
	telephone.		1	I
	he's going.		2	III
	my.		1	I
	him.		1	I
	he needs.		2	II
	chicken.		1	I
	cat.		1	I
	orange.		1	I
	loud.		1	I
	kitchen.		1	I
	near telephone.		2	II
	orange.		1	I
	ready.		1	I

Note: The tilde sign (~) indicates the use of a prompt to support the response.

Table A22
Cameron
Transcript of utterances and Brown's Stages

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 6 (A)	the hungrier.	7	2	II
	the hungry.		2	II
	an the hungrier.		3	III
	the hungry goat.		3	III
	the hungry goat.		3	III
	the hungry goat.		3	III
	the playground.		2	II
APRIL 6 (A)	goat ~	4	1	I
	eat shoe.		2	II
	yes.		1	I
	no.		1	I
APRIL 7 (A)	hi Irene.	6	2	II
	hungry goat.		2	II
	help.		1	I
	more goat.		2	II
	eat ~		1	I
	no.		1	I
APRIL 8 (A)	the hungry goat.	6	3	III
	the hungry goat.		3	III
	Irene help.		2	II
	eat ~		1	I
	yes.		1	I
	flower.		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 12 (A)	chapter book.	3	2	II
	book.		1	I
	no.		1	I
APRIL 15 (A)	the hungry goat.	6	3	III
	the hungry goat.		3	III
	lunch.		1	I
	yes.		1	I
	no.		1	I
	all done.		2	II
APRIL 15 (A)	hungry goat.	8	2	II
	the hungry goat.		3	III
	the to eat the hungry goat.		6	Post-V
	the hungry goat.		3	III
	the lunch.		2	II
	yes.		1	I
	breakfast sandwich lunch.		3	II
	no.		1	I
APRIL 27 (A)	the hungrier the eat the hungry goat.	10	7	Post-V
	the hungrier the hungry the cow the hungry goat.		9	Post-V
	the hungry goat.		3	III
	goat ate.		2	II
	goat ate ~		2	II
	little anytime shoe.		3	III
	the hungry goat.		4	IV
	was the hungry goat.		4	IV

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 28 (A)	yes.	7	1	I
	no.		1	I
	the hungry goat.		3	III
	the hungry goat.		3	III
	eat classes math.		3	III
	work.		1	I
	book book.		2	I
MAY 2 (B)	yes.	9	1	I
	good.		1	I
	the hungrier.		2	II
	the hungrier.		2	II
	the hungry an the hungrier.		5	Post-V
	the hungry goat.		3	III
	the hungry goat.		3	III
	the goat ~		2	III
	the goat eat ~		3	III
MAY 3 (B)	yes.	6	1	I
	no.		1	I
	the hungry goat eat ~		4	V
	help.		1	I
	goat the eat.		3	III
	flower ~		1	I
	yes no yes no yes no yes no.		8	II
MAY 3 (B)	all done.	7	2	II
	the hungry goat the hungry the.		6	V
	stop.		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 4 (B)	goat ate shoe.	9	3	III
	no.		1	I
	yes.		1	II
	more yes.		2	II
	yes no all done.		4	V
	the hungry goat.		3	III
	the hungry goat.		3	III
	the hungry goat.		3	III
	the hungry goat.		3	III
	yes yes yes.		3	III
	no.		1	I
	yes.		1	I
MAY 9 (B)	hungry goat the of course of course.	8	7	Post-V
	all done.		2	II
	help please.		2	II
	the hungry goat.		3	III
	hungry the hungry the goat.		5	Post-V
	help please.		2	II
	reads read book.		3	III
	goat eat book ~		3	III
	no.		1	I
	all done.		2	II
MAY 11 (B)	the hungrier the hungry goat.	11	5	Post-V
	the hungry goat the hungry goat the.		7	Post-V

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 12 (B)	goat hungry the goat hungry	13	6	Post-V
	the.			
	help please.		2	II
	hungry goat.		2	II
	goat eat ~		2	II
	help please.		2	II
	help please.		2	II
	yes no yes no.		4	V
	help please.		2	II
	all done.		2	II
	book.		1	I
	the eat.		2	II
	the hungrier.		2	II
	the hungry goat.		3	III
	hungry the goat.		3	III
	help thanking help.		3	III
	goat go.		2	II
	eat equipment.		2	II
	help please.		2	II
	help please.		2	II
MAY 13 (B)	ball ~	7	1	I
	do we want.		3	III
	all done.		2	II
	the hungry goat.		3	III
	hungry.		1	I
	the goat eat ~		3	III
	help please.		2	III

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 18 (B)	goat the the hungry.	7	4	IV
	goat eat trash ~		3	III
	all done.		2	III
	the hungry rooster.		3	III
	the hungry goat ~		3	III
	help please story.		3	III
	the hungry ball.		3	III
MAY 19 (B)	goat eat ball ~	8	3	III
	help please.		2	II
	all done.		2	II
	the hungry goat.		3	III
	the hungry goat eat.		4	V
	hungry cow.		2	II
	hungry goat the.		3	III
MAY 23 (B)	the hungry goat.	16	3	III
	the hungry goat.		3	III
	the hungry goat.		3	III
	flower.		1	II
	all done.		2	II
	the hungry goat.		3	III
	the goat hungry.		3	III
	goat the hungry.		3	III
	the hungry goat all done.		5	Post-V
	the.		1	I
	all done.		2	II
	help please.		2	II
	eat ~		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
	the hungry goat all done.		5	Post-V
	the hungry goat.		3	III
	on.		1	I
	the.		1	II
	the goat eat book.		4	V
	yes yes.		2	II
	no.		1	II
	all done.		2	II
MAY 24 (B)	the ~	4	1	I
	hungry goat.		2	II
	the goat eat book ~		4	V
	all done.		2	II
MAY 24 (B)	the hungry goat.	6	3	III
	all done.		2	II
	lunch ~		1	I
	no.		1	I
	lunch.		1	I
	all done.		2	II
MAY 25 (B)	the hungry goat.	7	3	III
	the dog ~		2	II
	the dog.		2	II
	dog.		1	I
	dog see frog.		3	III
	help please.		2	II
	all done.		2	II
MAY 26 (B)	hungry goat.	8	2	II

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 26 (B)	help please.	7	2	II
	play ~		1	I
	play puppy ~		2	II
	all done.		2	II
	help please.		2	II
	puppy see turtle.		3	III
	all done.		2	II
	the hungry.		2	II
	puppy.		1	I
	all done.		2	II
	all done.		2	II
	the puppy all done story.		5	Post-V
	the puppy saw frog ~		4	V
	all done.		2	II
MAY 27 (A)	the hungry puppy.	10	3	III
	the hungry puppy.		3	III
	the playing puppy ~		3	III
	the hungry puppy.		3	III
	yes.		1	I
	no.		1	I
	help.		1	I
	the puppy saw dog frog.		5	V
	frog.		1	I
	all done.		2	II
MAY 27 (A)	the hungry puppy.	6	3	III
	were computer.		2	II

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 31 (A)	help please.	7	2	II
	all done.		2	II
	the puppy saw a frog.		5	Post-V
	all done.		2	II
	the hungry chick.		3	III
	the hungry puppy.		3	III
	puppy.		1	II
	the play puppy ~		3	II
	hungry puppy.		2	II
	see frog ~		2	II
MAY 31 (A)	all done.	9	2	II
	I want helps.		3	III
	chick.		1	I
	puppy.		1	I
	all done.		2	II
	I.		1	I
	I want ~		2	II
	help please.		2	II
	the puppy saw frog.		4	V
	all done.		2	II
JUNE 1 (A)	the hungry puppy.	6	3	III
	the play puppy.		3	III
	the play playing ~		3	III
	all done.		2	II
	dog puppy frog.		3	III
	all done.		2	II

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 1 (A)	the hungry puppy.	6	3	III
	all done.		2	II
	play playing ~		2	I
	all done.		2	II
	puppy saw frog.		3	III
	all done.		2	II
JUNE 2 (A)	the hungry.	7	2	II
	the play playing frog.		4	III
	the play playing dog ~		4	III
	puppy ~		1	I
	all done.		2	II
	puppy see frog.		3	III
JUNE 2 (A)	all done.	11	2	II
	the hungry puppy.		3	III
	all done.		2	II
	hi.		1	I
	the to eat the hungry puppy.		6	Post-V
	the hungry puppy.		3	III
	story.		1	I
	the hungry puppy ~		3	III
	the the playing puppy.		4	III
	all done.		2	II
	the puppy frog.		3	III
JUNE 3 (A)	all done.	6	2	II
	the hungry puppy.		3	III
	all done.		2	II

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 3 (A)	play playing puppy.	8	3	II
	dog saw puppy frog.		4	V
	all done.		2	II
	all done.		2	II
	the hungry.		2	II
	the play playing puppy.		4	V
	puppy saw puppy play.		4	V
	all done.		2	II
	play playing ~		2	II
	all done.		2	II
JUNE 6 (B)	puppy saw frog.	4	3	III
	all done.		2	II
	the hungry puppy.		3	III
	puppy play playing ~		3	III
	puppy saw frog.		3	III
JUNE 6 (B)	all done.	7	2	II
	the hungry.		2	II
	the hungry skunk puppy.		4	V
	the play playing puppy ~		4	V
	all done.		2	II
JUNE 7 (B)	saw puppy frog ~	12	3	III
	the puppy saw an frog was.		6	Post-V
	all done.		2	II
	sandwich macaroni and cheese.		4	V
	sandwich.		1	I
	all done.		2	II

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 7 (B)	sandwich.	7	1	I
	puppy stop.		2	II
	help.		1	I
	you're welcome.		2	III
	stop.		1	I
	help please.		2	II
	the sandwich ~		1	I
	had eat lettuce.		3	III
	all done.		2	II
	an the sandwich.		3	III
	puppy.		1	I
	help please.		2	II
	the sandwich ~		2	II
	had lettuce on it ~		4	V
	most thankful.		2	II
JUNE 8 (B)	no I all done ~	13	4	V
	the cornflakes.		2	II
	the sandwich.		2	II
	the puppy.		2	II
	the hungry.		2	II
	all done.		2	II
	play playing.		2	II
	all done.		2	II
	sandwich.		1	I
	sandwich.		1	I
	play play.		2	II

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 9 (B)	the sandwich ~	9	2	II
	had condiment.		2	II
	all done.		2	II
	the sandwich.		2	II
	puppy.		1	I
	the sandwich.		2	II
	frog.		1	I
	help please were.		3	III
	meat ~		1	I
	of course.		2	II
JUNE 9 (B)	no.	6	1	I
	I I'm of course all done.		6	Post-V
	the french toast.		3	III
	the sandwich.		2	II
	is the puppy.		3	III
	the tomato ~		2	II
JUNE 10 (B)	of course.	8	2	II
	all done.		2	II
	sandwich.		1	I
	all done.		2	II
	sandwich.		1	I
	help please.		2	II
	bread ~		1	I
	all done.		2	II
	no.		1	I
	all done ~		2	II

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 10 (B)	the sandwich.	5	2	II
	puppy.		1	I
	help please.		2	II
	lime butter lettuce.		3	III
	all done.		2	II
JUNE 13 (B)	puppy.	6	1	I
	the sandwich.		2	II
	help are please.		3	III
	help please.		2	II
	lettuce ~		1	I
	all done.		2	II
JUNE 13 (B)	an are help are the.	7	5	V
	turtle ~		1	I
	all done.		2	II
	dog.		1	I
	help please.		2	II
	little.		1	I
	all done.		2	II
	the sandwich.		2	II
JUNE 14 (B)	puppy.	10	1	I
	turtle ~		1	I
	help please.		2	II
	turtle is walking ~		3	III
	all done.		2	II
	no.		1	I
	I of course.		3	III

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 14 (B)	no.	7	1	I
	all done.		2	II
	the sandwich.		2	II
	puppy.		1	I
	help please.		2	II
	yes.		1	I
	lettuce ~		1	I
JUNE 14 (B)	all done.	5	2	II
	all done.		2	II
	the sandwich.		2	II
	puppy.		1	I
	help please.		2	II
	tomato ~		1	I
	all done.		2	II
JUNE 15 (B)	the the turtle.	7	3	II
	the sandwich.		2	II
	puppy.		1	I
	the turtle.		2	II
	help please.		2	II
	turtle is little ~		3	III
	all done.		2	II
JUNE 15 (A)	the turtle.	10	2	II
	sandwich.		1	I
	puppy.		1	I
	turtle is turtle ~		3	III
	all done.		2	II

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 16 (A)	turtle is turtle.	7	3	III
	help please.		4	V
	the turtle is funny ~		1	I
	no.		2	III
	I all done.		3	III
	the turtle.		2	II
	sandwich puppy.		2	II
	turtle is turtle.		3	III
	help please.		2	II
	the turtle is walking ~		4	V
JUNE 16 (A)	no.	8	1	I
	I all done.		3	III
	the turtle.		2	II
	sandwich.		1	I
	puppy.		1	I
	winter ~		1	I
	help please.		2	II
	hat.		1	I
	all done.		2	II
	all done.		2	II
JUNE 17 (A)	the.	10	1	I
	help please.		2	II
	fun winter ~		2	II
	winter.		1	I
	winter.		1	I
	of course.		2	II

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 17 (A)	all done.	9	2	II
	help please.		2	II
	mittens ~		1	I
	all done.		2	II
	the winter.		2	II
	help please.		2	II
	fun ~		1	I
	winter fun ~		2	II
	help please.		2	II
	winter.		1	I
	help please.		2	II
	winter are hat ~		3	III
	all done.		2	II

Table A27**Ruth****Transcript of utterances and Brown's Stages**

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 8 (A)	good.	3	1	I
	play.		1	I
	no.		1	I
APRIL 11 (A)	play.	3	1	I
	funny.		1	I
	toy.		1	I
APRIL 12 (A)	I want goldfish.	3	3	III
	funny play.		2	II
	tired.		1	I
APRIL 14 (A)	play.	4	1	I
	toy.		1	I
	tired.		1	I
	not hungry.		2	II
APRIL 25 (A)	I want goldfish.	12	3	III
	Grampy.		1	I
	Grammy.		1	I
	because I went on vacation.		5	Post-V
	I want to see he ate with cartoon.		8	Post-V
	I see fire work.		4	V
	ask.		1	I
	butter.		1	I
	I.		1	I
	I feel silly.		3	III

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
APRIL 26 (A)	I feel happy.	4	3	III
	I want.		2	II
	I want goldfish.		3	III
	funny.		1	I
	hungry.		1	I
APRIL 26 (A)	tired goldfish.	4	2	II
	I want goldfish.		3	III
	funny.		1	I
	tired.		1	I
	hungry.		1	I
APRIL 27 (B)	I want goldfish.	5	3	III
	funny.		1	I
	a.		1	I
	I want goldfish.		3	III
	funny.		1	I
APRIL 28 (B)	I want goldfish.	3	3	III
	funny.		1	I
	wet hungry goldfish.		3	III
APRIL 28 (B)	I want goldfish.	3	3	III
	funny hungry goldfish.		3	III
	no.		1	I
APRIL 29 (B)	I want goldfish.	3	3	III
	funny play goldfish.		3	III
	hungry goldfish.		3	III
MAY 2 (B)	I want goldfish.	4	3	III
	I look.		2	II

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
	goldfish tired.		2	II
	goldfish hungry.		2	II
MAY 3 (B)	I want goldfish.	3	3	III
	funny tired goldfish.		3	III
	hungry goldfish.		2	II
MAY 4 (B)	I want goldfish.	3	3	III
	funny tired goldfish.		3	III
	hungry goldfish.		2	II
MAY 5 (B)	I want goldfish.	3	3	III
	funny tired goldfish.		3	III
	hungry goldfish.		2	II
MAY 9 (B)	I want goldfish.	3	3	III
	funny wet goldfish.		3	III
	hungry goldfish.		2	II
MAY 10 (B)	I want monkey.	4	3	III
	toy.		1	I
	I want monkey.		3	III
	hungry monkey.		2	II
MAY 11 (B)	I want monkey.	3	3	III
	tired monkey.		2	II
	hungry monkey.		2	II
MAY 12 (B)	I want monkey.	4	3	III
	funny.		1	I
	toy monkey.		2	II
	hungry monkey not.		3	III
MAY 17 (B)	she wanted a dog ~	3	4	V

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 18 (B)	she works hard.	4	3	III
	she walk to pet dog ~		5	Post-V
	she want.		2	II
	she wanted a dog ~		4	V
	she worked hard ~		3	III
MAY 19 (B)	she walk to dog ~	4	4	V
	she wanted cat.		3	III
	a dog ~		2	III
	she worked hard ~		3	III
	she walk to dog ~		4	V
MAY 24 (A)	she walk to dog.	5	4	V
	she is an.		3	III
	a hard work.		3	III
	she work hard ~		3	III
	she wanted a dog ~		4	V
MAY 24 (A)	I.	4	1	I
	she wanted a dog ~		4	V
	she work a hard ~		4	V
	she walk walk to cat cat like dog.		8	Post-V
	she wanted a cat.		4	V
MAY 25 (A)	dog ~	5	1	I
	she walk.		2	II
	she work hard ~		3	III
	she walk to dog.		4	V
	she wanted a cat.		4	V
MAY 25 (A)	dog.		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
MAY 26 (A)	she walk.	3	2	II
	she work hard.		3	III
	she walk to dog.		4	V
	she wanted a dog.		4	V
	she work hard.		3	III
MAY 26 (B)	she walk to dog.	3	4	V
	she wanted an a dog.		5	V
	she work hard.		3	III
MAY 27 (B)	she walk to cat dog.	4	5	Post-V
	she wanted a dog.		4	V
	she work hard.		3	III
	she walk.		2	II
JUNE 1 (B)	she walks to dog.	4	4	V
	no.		1	I
	me wanted monkey.		3	III
	I wanted monkey.		3	III
	a mountain.		2	II
JUNE 1 (B)	she wanted a dog.	3	3	III
	walk ~		1	I
	food.		1	I
JUNE (B)	I wanted monkey.	4	3	III
	funny.		1	I
	mountain.		1	I
	no.		1	I
JUNE 2 (B)	she wanted a dog.	3	4	V
	walk.		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 3 (B)	food.	3	1	I
	she wanted a dog.		4	V
	walk.		1	I
JUNE 6 (B)	hungry.	4	1	I
	she wanted a dog.		4	V
	I want to work hard.		5	Post-V
	I.		1	I
JUNE 6 (B)	no.	3	1	I
	she wanted a dog.		4	V
	she work hard.		3	III
JUNE 7 (B)	she walk walk to dog.	3	5	V
	she wanted a dog.		4	V
	she wanted worked a hard.		5	Post-V
JUNE 7 (B)	she walk to dog.	3	4	V
	she wanted a dog.		4	V
	she wanted work hard.		4	V
JUNE 8 (B)	she walk to dog.	3	4	V
	she wanted a dog.		4	V
	she wanted work hard.		4	V
JUNE 8 (B)	she walk to dog.	4	4	V
	she wanted a pet dog.		5	Post-V
	she wanted work hard.		4	V
JUNE 9 (B)	she wanted.	3	2	II
	she walk to dog.		4	V
	she wanted a dog.		4	V
	she worked a hard.		4	V

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 9 (B)	she walk to dog.	3	4	V
	she wanted a dog.		4	V
	she work hard.		3	III
JUNE 10 (A)	she walk to its dog.	5	5	Post-V
	she wanted a dog.		4	V
	she work was harder.		4	V
	she walked.		2	II
	she walk to it thinks.		5	Post-V
JUNE 13 (A)	she walk to dog.	3	4	V
	she wanted a dog.		4	V
	she worked a work hard.		5	Post-V
JUNE 13 (A)	she walk to dog.	3	4	V
	she wanted a dog.		4	V
	she work hard.		3	III
JUNE 14 (A)	she walk to dog.	3	4	V
	she wanted a dog.		4	V
	she work a hard.		4	V
JUNE 14 (A)	she walk to dog.	3	4	V
	she wanted a dog.		4	V
	she worked hard hardens hard.		5	V
JUNE 14 (A)	she walk to dog.	3	4	V
	she wanted a dog.		4	V
	she work hard.		3	III
JUNE 15 (A)	she walk to dog.	3	4	V
	she wanted a dog.		4	V
	she work hard.		3	III

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCES	BROWN'S STAGES
JUNE 15 (A)	she walk to dog.	3	4	V
	she wanted a dog.		4	V
	she work hard.		3	III
JUNE 17 (A)	she walk to dog.	3	4	V
	she wanted a dog.		4	V
	she work a harder not.		5	Post-V
JUNE 17 (A)	she walk to dog.	3	4	V
	she wanted a dog.		4	V
	she work hard.		3	III
	she walk to dog.		4	V

Appendix B
Summary of Communication Intent/Function per Student

Table B8**Brenden**

Communication Intent/Function Summary based on the Functional Communication Profile-R (Klieman, L. L., 2003)

COMMUNICATION INTENT/ FUNCTION	PRETEST	POST- TEST	COMMENTS: NOTES ANY CHANGES
REQUEST ITEM/ACTION	yes	yes	
ASK FOR "MORE"	yes	yes	
GAIN ATTENTION	yes	Yes	
PROTEST/RESIST	yes	yes	Post-test: used device more during the session to appropriately protest.
GREET/TAKE LEAVE	yes	yes	
COMMAND	yes	yes	Level of complexity can vary based on status and willingness to comply.
REQUEST ASSIST	no	yes	Will initiate using his device to request help and pair with a verbalization followed by direct eye-contact for confirmation by a staff person.
INFORM ABOUT SELF	yes	yes	With varied levels of prompting. Conveys feelings as well as identifying health needs.
PROVIDE INFORMATION	yes	yes	Will use the AAC device to provide requested information with minimal prompting.
SHOWS INTEREST IN OTHERS/ACTIVITY	yes	Yes	
TO PLAY WITH OTHERS	yes	yes	
CALL/SUMMON	yes	Yes	
SEEK DIRECT/CARE	yes	yes	Will use device now to request help.
ASSERT SELF	yes	yes	
SEEK AFFECTION	yes	yes	
SEEK APPROVAL	yes	yes	

COMMUNICATION INTENT/ FUNCTION	PRETEST	POST- TEST	COMMENTS: NOTES ANY CHANGES
INTERRUPT OTHERS	yes	yes	Use of the AAC device with increasingly complex responses relevant to the context of the story was documented.
SOCIALIZE	yes	yes	
COMMENT	yes	Yes	
ARGUE OR DISAGREE	yes	yes	
DENY/NEGATE	yes	yes	
AFFIRM	yes	yes	

Note: The highlighted sections in yellow are specific changes noted in the posttest.

Table B13**Sam****Communication Intent/Function Summary based on the Functional Communication Profile-R (Klieman, L. L. 2003)**

COMMUNICATION INTENT/FUNCTION	PRETEST	POST-TEST	COMMENTS: NOTES ANY CHANGES
REQUEST INTENT/FUNCTION	yes	yes	
REQUEST ITEM/ACTION	yes	yes	
ASK FOR "MORE"	yes	yes	Able to convey delays in receiving more.
GAIN ATTENTION	yes	yes	
PROTEST/RESIST	yes	yes	
GREET/TAKE	yes	yes	
LEAVE			
COMMAND	yes	yes	
REQUEST ASSIST	yes	yes	
INFORM ABOUT SELF	yes	yes	
PROVIDE INFORMATION	yes	yes	He is using increasingly complex utterance to convey information.
SHOWS INTEREST IN OTHERS/ACTIVITY	yes	yes	
TO PLAY WITH OTHERS	yes	yes	He has expanded the use of his utterances to interact with both speaking peers and those that use SGDs and other forms of communication.
CALL/SUMMON	yes	yes	
SEEK	yes	yes	
DIRECT/CARE			
ASSERT SELF	yes	yes	Had the video stopped and started 3x during first taping.
SEEK AFFECTION	yes	yes	
SEEK APPROVAL	yes	yes	

COMMUNICATION INTENT/FUNCTION	PRETEST	POST-TEST	COMMENTS: NOTES ANY CHANGES
INTERRUPT	yes	yes	
OTHERS			
SOCIALIZE	yes	yes	Engages using his SGD more often and with expanded utterances.
COMMENT	yes	yes	Comments are linked to the context and also indicate an ability to relate his likes, activities etc. to another person or character in the story.
ARGUE OR DISAGREE	yes	yes	
DENY/NEGATE	yes	yes	
AFFIRM	yes	yes	

Note: The highlighted sections in yellow are specific changes noted in the posttest.

Table B18**Holly****Communication Intent/Function summary based on the Functional Communication Profile-R (Klieman, L.L., 2003)**

COMMUNICATION INTENT/FUNCTION	PRETEST	POST-TEST	COMMENTS: NOTES ANY CHANGES
REQUEST INTENT/FUNCTION	Yes	Yes -expanded	Holly refined what she wanted through increased vocabulary
REQUEST ITEM/ACTION	Yes	Yes- expanded	Requested early on to engage in her literacy sessions when the interventionist was absent.
ASK FOR "MORE" GAIN ATTENTION	Yes Yes	Yes Yes- more specific	Holly will now use her SGD to call for specific people or classmates
PROTEST/RESIST	Yes	Yes- expanded	Holly is now more specific as to what she is saying no to and uses both yes and no vs. only indicating no the first time something is asked.
GREET/TAKE LEAVE	Yes	Yes- expanded	Holly initiates greetings with staff and peers and requires no prompting. She also clearly indicated if she wanted to talk more or end the literacy session.
COMMAND	Yes	Yes -expanded	Holly will follow simple commands using her device to answer questions or attempt to find a specific page in relationship to the

COMMUNICATION INTENT/FUNCTION	PRETEST	POST-TEST	COMMENTS: NOTES ANY CHANGES
			activity she is participating in.
REQUEST ASSIST	Yes	Yes	
INFORM ABOUT	Yes	Yes	
SELF			
PROVIDE	No	Yes	
INFORMATION			
SHOWS INTEREST	Yes	Yes	
IN			
OTHERS/ACTIVITY			
TO PLAY WITH	Yes	Yes	
OTHERS			
CALL/SUMMON	Yes	Yes -expanded	Holly will call people by name using her device and initiate interactions with a variety of intents.
SEEK	No	No	
DIRECT/CARE			
ASSERT SELF	No	Yes	
SEEK AFFECTION	No	No	
SEEK APPROVAL	Yes	Yes	
INTERRUPT	No	No	
OTHERS			
SOCIALIZE	No	Yes	
COMMENT	No	Yes	
ARGUE OR	No	No	
DISAGREE			
DENY/NEGATE	Yes	Yes -expanded	Holly is much more specific in this area using not just the word "no" appropriately but also words like "not"
AFFIRM	Yes	Yes	

Note: The highlighted sections in yellow are specific changes noted in the posttest.

Table B23**Cameron****Communication Intent/Function Summary based on the Functional Communication Profile-R (Klieman, L. L., 2003)**

COMMUNICATION INTENT/FUNCTION	PRETEST	POST-TEST	COMMENTS: NOTES ANY CHANGES
REQUEST INTENT/FUNCTION	yes	yes	
REQUEST ITEM/ACTION	yes	yes	He attempted to change topics during the literacy sessions to gain access to preferred activities/items such as food.
ASK FOR "MORE"	yes	yes	
GAIN ATTENTION	yes	yes	
PROTEST/RESIST	yes	yes	This is an area of growth. Cameron started by using the word "no" and expanded to "all done" using his device and appropriately communicating.
GREET/TAKE LEAVE COMMAND	Yes (with prompting) emerging emerging	yes emerging yes	
REQUEST ASSIST			Cameron made significant progress in this area. He will initiate requesting help using his device and signing.
INFORM ABOUT SELF	no	no	
PROVIDE INFORMATION	yes	yes	Cameron was able to expand upon the type of information provided in relationship to the content of a text across several different books as

COMMUNICATION INTENT/FUNCTION	PRETEST	POST-TEST	COMMENTS: NOTES ANY CHANGES
			well as engaging in word play.
SHOWS INTEREST IN OTHERS/ACTIVITY TO PLAY WITH OTHERS	yes	yes	
CALL/SUMMON SEEK	emerging emerging	emerging emerging	
DIRECT/CARE ASSERT SELF	emerging	emerging	Cameron would attempt to redirect the conversation or indicate that he would like to eat vs. complete the literacy session.
SEEK AFFECTION SEEK APPROVAL INTERRUPT OTHERS	yes yes yes	yes yes yes	
SOCIALIZE COMMENT	yes yes	yes yes	Cameron expanded the type of word forms he used to add additional information to the comments made related to the text.
ARGUE OR DISAGREE DENY/NEGATE AFFIRM	yes yes yes	yes yes yes	

Note: The highlighted sections in yellow are specific changes noted in the posttest.

Table B28**Ruth****Communication Intent/Function Summary based on the Functional Communication Profile-R (Klieman, L.L., 2003).**

COMMUNICATION INTENT/FUNCTION	PRETEST	POST-TEST	COMMENTS: NOTES ANY CHANGES
REQUEST INTENT/FUNCTION	yes	yes	
REQUEST ITEM/ACTION	yes	yes	
ASK FOR "MORE"	yes	yes	
GAIN ATTENTION	yes	yes	
PROTEST/RESIST	yes	yes	
GREET/TAKE LEAVE	yes	yes	
COMMAND	yes	yes	
REQUEST ASSIST	yes	yes	
INFORM ABOUT SELF	yes	yes	During the sessions Ruth was able to talk about things she did in the recent past such as over the weekend. These conversations were initiated by Ruth. Ruth was able to show gradual increases in the ability to provide specific information regarding the test read.
PROVIDE INFORMATION	yes	yes	
SHOWS INTEREST IN OTHERS/ACTIVITY	yes	yes	
TO PLAY WITH OTHERS	yes	yes	
CALL/SUMMON	yes	yes	
SEEK	yes	yes	
DIRECT/CARE			
ASSERT SELF	yes	yes	
SEEK AFFECTION	yes	yes	
SEEK APPROVAL	yes	yes	During the study Ruth consistently looked to the

COMMUNICATION INTENT/FUNCTION	PRETEST	POST-TEST	COMMENTS: NOTES ANY CHANGES
			interventionists to seek approval for each response or to engage in a social interaction of her choosing.
INTERRUPT OTHERS	yes	yes	
SOCIALIZE	yes	yes	Ruth greeted and indicated when the activity was over as well (generally by signing vs. using the SGD). She recalled activities she had participated in and people she visited.
COMMENT	yes	yes	Ruth's quality of her comments related to the story advanced throughout the study. This is an area of significant growth.
ARGUE OR DISAGREE	yes	yes	
DENY/NEGATE	yes	yes	
AFFIRM	yes	yes	Ruth consistently affirms her responses and looks for affirmation back that the response was correct. She is a total communicator and will use signs, facial expressions and her SGD to convey and affirm her thoughts.

Note: The highlighted sections in yellow are specific changes noted in the posttest.

Appendix C
Transcript of Generalization Phases per Student

Table C9
Brenden
Generalization Transcript (Five sessions) with Brown's Stages

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCE	BROWN'S STAGES
JUL 18	email.	9	1	I
	email.		1	I
	email.		1	I
	email.		1	I
	web ~.		1	I
	bee bee.		2	II
	butterfly.		1	I
	yes.		1	I
	caterpillar		2	II
	butterfly.			
JUL 18	story.	6	1	I
	email email.		2	II
	pet.		1	I
	TV Guide email		5	N/A
	vacuum cleaner.			
	yes.		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCE	BROWN'S STAGES
	email.		1	I
JUL 20	book.	6	1	I
	happier.		1	I
	email.		1	I
	Sadder ~.		1	I
	Yes.		1	I
	happy.		1	I
JUL 20	email occupation card.	5	3	III
	email.		1	I
	happy.		1	I
	maybe.		1	I
	no.		1	I
JUL 27	book.	7	1	
	TV Guide email.		3	N/A
	Whale.		1	I
	will it.		2	II
	it saw it octopus.		4	V
	email.		1	I
	no.		1	I

Note: The tilde sign (~) indicates the use of a prompt to support the response. Incorrect responses (those that do not connect to the story or the question asked) have been highlighted.

Table C14

Sam

Generalization Transcript (5 sessions) with Brown's Stages

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCE	BROWN'S STAGES
18-JUL	mean.	4	1	I
	building.		1	I
	he builds for guitar.		4	Post-V
	no.		1	I
JULY 18PM	our country.	3	2	II
	we love our quiet country.		5	Post-V
	no.		1	I
20-JUL	he did.	4	2	II
	he has a dog.		4	Post-V
	busy he he's busy.		4	Post-V
	no.		1	I
JULY 20PM	you thank nun church choir.	11	5	Post-V
	that's interesting tell me more.		5	Post-V
	just kidding.		2	II
	how are you?		3	III
	good idea.		2	II
	good idea.		2	II
	good idea.		2	II
	good idea.		2	II
	she is.		2	II
	do I.		2	II
	no.		1	I
27-JUL	cat like to play.	4	4	Post-V
	lion like eat animal.		4	Post-V
	yes.		1	I
	no.		1	I

Table C19
Holly
Generalization Transcript (5 sessions) with Brown's Stages

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCE	BROWN'S STAGES
JUL 18	to see me.	4	3	III
	color ready color		5	Post-V
	ready wait.			
	orange.		1	I
	cat.		1	I
JUL 19	he cat.	2	2	II
	blue?		1	I
JUL 20	dog cat living room.	4	4	V
	orange.		1	I
	yes.		1	I
	heels.		1	I
JUL 21	cat.	3	1	I
	shoe red.		2	II
	no.		1	I
JUL 27	look cat.	4	2	II
	hi hi heels.		3	III
	yes.		1	I

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCE	BROWN'S STAGES
	orange yes yes maybe maybe no.		6	Post-V

Table C24
Cameron
Generalization Transcript (5 sessions) with Brown's Stages

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCE	BROWN'S STAGES
JUL 27	She she help please. swimming. all done.	3	4 1 2	IV I II
AUG 2	sandwich. lettuce. yes. all done.	4	1 1 1 2	I I I II
AUG 2	turtle to meet. big. yes. yes. no.	5	3 1 1 1 1	III I I I I
AUG 3	hi Irene. the hungry goat.	5	2 3	II III

DATE	UTTERANCES	NUMBER OF RESPONSES	LENGTH OF UTTERANCE	BROWN'S STAGES
	more goat.		2	II
	eat.		1	I
	no.		1	I
AUG 3	the hungry goat.	7	3	III
	goat the hungry		4	Post-V
	goat.			
	hi Irene.		2	II
	help.		1	I
	eat.		1	I
	yes.		1	I
	flower.		1	I

Table C29
Ruth
Generalization Transcript (5 sessions) with Brown's Stages

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCE	BROWN'S STAGES
JUL 5	she want a.	4	3	III
	it had dog.		3	III
	she work hard.		3	III
	she walk to dog.		3	Post-V
JUL 6	she want a dog.	3	4	Post-V
	she work a hard.		4	Post-V
	she walk to dog.		4	Post-V
JUL 7	she want a dog.	3	4	Post-V
	she work a hard.		4	Post-V

DATE	UTTERANCE	NUMBER OF RESPONSES	LENGTH OF UTTERANCE	BROWN'S STAGES
	she walk to dog.		4	Post-V
JUL 11	she wanted a dog.	3	4	Post-V
	she work a hard.		4	Post-V
	she walk to dog.		4	Post-V
JUL 12	she want a dog.	3	4	Post-V
	she work a hard.		4	Post-V
	she walk to dog.		4	Post-V

Appendix D Interview Questions

- Please tell me overall your impressions of the study. Think about this in terms of student impact and then in terms of the impact on you.
- Given this definition of communication (Communication is the sharing of information across a variety of modalities), tell me how you think the LAMP method and intervention impacted the student's communication?
- Can you tell me more about the student's use of communication functions keeping this definition in mind; Gail Van Tatenhove (2007) discusses communication function as relational functions. That is, communication functions are those acts which have a pragmatic component such as but not limited to; directives, requests, associatives, naming and greeting (p. 4). The variety and complexity of communication functions can range from a single word to complex sentences.
- How did LAMP and this intervention impact communication at other times during the day or in other settings?

- Given this definition of vocabulary (vocabulary is commonly taken to mean a set of words or phrases), tell me how you think the LAMP method and intervention impacted the student's vocabulary?
- If you had to convey three important takeaways from this study, what would they be?
- How did your previous training and experience as well as the training provided for the intervention impact your implementation and participation in the study?
- What role does collaboration play in all of this?
- Would you like to tell me anything else?

Appendix E
Interventionist Data Recording Sheet

Student # _____

Staff # _____

Date:

Book Title & pages read: _____

Time:

Prompting (circle)	Word(s) – list requiring prompts only	Modeling by adult – word list	Comments
IC DVC DPC PA			
IC DVC DPC PA			
IC DVC DPC PA			
IC DVC DPC PA			

Prompting (circle)	Word(s) – list requiring prompts only	Modeling by adult – word list	Comments
IC DVC DPC PA			
IC DVC DPC PA			
IC DVC DPC PA			

Prompt Definitions:

Indirect Cue (IC): Verbal comment repeating or rephrasing initial response, gesture, using a light/laser to point at communication device but not at any specific symbol.

Direct Verbal Cue (DVC): Verbally direct a response by restating the initial response and indicating the appropriate response in return.

Direct pointer Cue (DPC): Directly showing the location of the initial or next symbol to be selected.

Physical Assistance (PA): Physically assist the AAC user in activating the message on their device.

Student Open Ended Questions Used in Each Session: (You do not need to write answers with language activity monitor on)

1. Tell me something about this book from what you have read so far.
2. What do you think the main character would want you to know about them?
3. Would you like to tell me something else about the book? If, yes the student may proceed to answer in more detail.