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EFFECTS OF GRID BASED AAC APPS TO SUPPORT ACADEMIC SIGHT WORD LEARNING IN AN INDIVIDUAL WITH ASD

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ABSTRACT

Reading is a gateway to knowledge and opportunities. For individuals with complex communication needs (CCN), including individuals with autism, gaining access to literacy supports freedom of expression and full participation in critical education opportunities. Changes in federal policy have promoted a new emphasis on teaching academic content to all students, including those with disabilities. This includes individuals with CCN who require or benefit from augmentative and alternative communication (AAC). Grid-based AAC systems commonly use combinations (or paired) text and graphic symbols to represent concepts that individuals communicate with. Access to AAC has the potential to support communication, yet when re-designed, may have the potential to support literacy as well.

A single subject across sight word sets pilot study has been conducted with one individual with ASD and CCN, to investigate the effect of a new software feature (i.e., the transition to literacy (T2L) software feature dynamically presents text, paired with speech output, upon selection of a specific graphic symbol in the AAC device). General curriculum academic content of landform vocabulary (e.g., volcano, marsh, pond) was taught using only the T2L software feature. The participant in this study demonstrated improved sight word learning from baseline, learning to read 15 new landform words. This study provides preliminary evidence that AAC system design changes have the potential to improve communication and sight word learning, as well as and provide a way to integrate general curriculum involvement and progress.

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Chapter 1

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by social impairments, communication delays, and non-typical behaviors (Center for Disease Control, 2014). Subsequently, challenges often include difficulty with social interaction, understanding nonverbal communication as well as restricted interests, repetitive behavior, and sensitivity to sensory stimuli (Ganz, 2015). 30% of individuals with ASD do not develop functional speech (Tager-Flusberg, & Kasari, 2013) and subsequently have complex communication needs (CCN; limited ability to communicate with speech and benefit from augmentative and alternative communication supports). Individuals with ASD and CCN require strategies to support participation, inclusion in the general curriculum, and expression (Calculator, 2009).

According to the Center for Disease Control, ASD prevalence has increased from 1 in 88 in 2008 to 1 in 68 in 2016 (Wright, 2017). As more children with ASD and ASD characteristics enter school, changes in federal policy have promoted an emphasis on inclusion and positive education outcomes for all students (Knight, Browder, Agnello, & Lee, 2010). This includes those who require AAC to communicate and participate. These students must have access, be involved, and progress in the general curriculum, therefore, instruction must be adapted to meet their needs (Knight et al. 2010; Light & McNaughton, 2013). A critical component to education and lifelong learning is literacy. Literacy is the "cornerstone for a child's success in school and . .

. life" (Anderson, Hiebert, Scott, & Wilkinson, 1985, p. 1). Literacy provides access to academic, vocational, and recreational opportunities and supports independence for individuals with communication disorders (Koppenhaver & Yoder, 1992). With access to literacy, students with ASD are able to facilitate relationships, participate more fully in education, and use mainstream technologies for leisure and communication (e.g., texting, social media, email) (Caron & Light, 2016; Light & McNaughton, 2010).

Literacy Instruction

Legislation mandates (e.g., The No Child Left Behind Act of 2001 (NCLB) and IDEA 2004) that all children be provided explicit and systematic classroom reading instruction (Delano, Otabio, & Whalon, 2010). Research has found that formal literacy instruction is essential for acquiring literacy skills (Adams, 1990; Lonigan & Shanahan, 2008). The National Reading Panel suggests that reading instruction be provided for 90 minutes a day, and that early literacy skills should be targeted and built upon (e.g., letter-sound correspondences, decoding, sight words, shared reading) (National Reading Panel, 2000).

Sight Word Instruction

Sight word instruction is a literacy instruction approach that teaches students word recognition instead of a relationship between sounds and letters in a word (Browder and Xin 1998). Sight word instruction is a foundational skill in learning to read and can provide a sense of accomplishment and motivation (Broun, 2004; Light & McNaughton, 2013). Sight word instruction can help students build a foundation in literacy (Spector, 2011), allowing students to see a relationship between words and meaning (Broun, 2004). Mastery of sight words can allow students to participate in functional tasks such as following grocery lists, reading directions, schedules, and recipes (Browder and Xin 1998). Sight word learning can additionally support improved communication and access to leisure (e.g., use of YouTube) (Caron & Light, 2016).

Sight word interventions are common approaches used in literacy instruction for individuals with moderate and severe disabilities (Browder & Xin, 1998), yet, limited research includes individuals with ASD and CCN (Spector, 2011). Spector (2011) reviewed single-subject research from 1980 to 2009 on sight word instruction for individuals with ASD and found only nine single-subject sight word studies. Of the nine, six of these studies included individuals with ASD without CCN and used instructional and/or assessment tasks that required spoken responses (e.g., Collins & Stinson, 1994). More recently, Mandak and colleagues (2017) completed a systematic review to investigate the effects of literacy instruction on single-word reading of individuals who use aided AAC. A systematic search identified 24 individuals across nine single-case experimental design studies, 14 of the 24 had a diagnosis of ASD. In review of the research, sight word instruction varied in terms of approaches, ranging from use of computer-mediated approaches to low-tech approaches, as well as a range in the words selected for interventions. Most commonly the sight words included words for objects that were easy to represent in pictures (e.g., household items, food items, clothing items) (Fossett & Mirend, 2006; Hetzroni & Shalem, 2005, Van der Meer et al., 2014); only one study included words from “high-frequency” lists (e.g., Dolch Words) (Crowley et al., 2013). No studies included words based on personal relevance, such as interests (e.g., TV and movie characters, places visited) and activities (e.g., music, sports) in the learner’s life.

Instruction for individuals with CCN

Many literacy approaches assume students have the spoken language to participate (e.g., orally stating a sound aloud when a letter card is presented, or reading a sentence aloud with fluency). The inability to produce intelligible speech has the potential to negatively impact participation in literacy instruction, which often leads to fewer opportunities for participation or a lack of quality instruction adapted to meet their needs (Caron, 2016). If students do not have the spoken language ability to participate, teachers need to use alternative and adapted literacy instruction methods (Coleman-Martin, Heller, Cihak, & Irvine, 2005; Light & McNaughton, 2013). Research has demonstrated that with adapted and explicit instruction individuals with ASD who use AAC can learn to read (Caron, 2016; Light & McNaughton, 2013). For example, in Caron's 2016 study on adapted instruction for acquisition of sight words, learners with severe ASD and CCN improved their sight-word reading accuracy through adapted evidence-based instructional practices. In a single subject study with children with ASD, Spector (2011) found that adult directed intervention and modification of task instruction are effective elements of sight word instruction. Despite the evidence that individuals with ASD who use AAC can learn, the statistics for those leaving school without even functional literacy skills are bleak (Foley & Wolter, 2010).

AAC system use to support sight word learning

In order to change current poor outcomes, Light and colleagues (2014), have proposed to use current AAC systems with minor system design changes. Currently, grid-based AAC systems commonly use combinations (or paired) text and graphic symbols to represent concepts that individuals communicate with. Previous research has demonstrated the static pairing of print and graphic symbols, blocks word learning (blocking effect) but there is evidence that picture-to-text matching can successfully teach sight word learning (Fossett & Mirenda, 2006). Although using pictures to learn sight words can cause the blocking effect, when students are actively matching pictures to texting, the blocking effect did not occur. (Fossett & Mirenda, 2006).

Emerging research is demonstrating positive effects of the unpairing of text and symbols on sight word learning. For example, in a study by Caron and colleagues (2018), all five participants with ASD and CCN learned motivating sight words through exposure to dynamic text features within a graphic grid display. In addition, with only exposure to the sight words through the AAC system, all participants were able to transition from graphic-based AAC grid displays to text only grid display (Caron et al., 2018). Using similar software features (i.e, dynamic text appearing from the graphic symbol, paired with speech output), but with use of visual scene display, Mandak and colleagues (2017) found that young individuals with ASD were able to acquire highly familiar vocabulary through book reading (e.g., Brown Bear book) (Mandak et al., 2017).

To date, no research has investigated sight word instruction with academic related vocabulary. AAC systems can be modified for students with CCN and ASD to participate and gain access to the general curriculum, with the integration of academic related vocabulary within their AAC system. This study aimed to investigate the integration of content specific academic vocabulary, based on common core standards, in a grid-based AAC system, to support sight word learning. Although best practices would include literacy instruction in addition to the AAC system, in order to isolate the variable of the effects of the AAC system with the transition to literacy software feature, the study solely used the AAC system. The study therefore aimed to investigate the acquisition, generalization, and maintenance of single-word reading of 15 academic words, by individuals with ASD, complex communication needs, and limited literacy skills, through the use of the transition to literacy software feature within an AAC app.

Chapter 2

Methods

Research Design

This study implemented a single-subject multiple-probe, across-word set design with one participant. The independent variable for the study was the exposure to an AAC app with transition to literacy (T2L) software features (i.e., dynamic text and speech output upon selection of a graphic symbol). The dependent variable measured the student's accuracy of reading 15 landform words (five words across three word sets). More specifically the dependent variable for the study was the percentage correct during the sight word reading probes; specifically, the number of correct graphic symbols selected from a field of four when provided with a target written word, across 10 trials (each word proved twice). The dependent variable was repeatedly measured before, during, and after treatment to determine the changes in behavior. When an intervention effect was established with the first word set (i.e., a score of 20% above the baseline average for two consecutive sessions), intervention with the second set began.

Participants

Paraprofessional. A paraprofessional provided the individual with ASD access to intervention materials, including the AAC system. The paraprofessional in the study was 34 years old. The paraprofessional has worked as a para educator for two years and worked with the participant for one year prior to the study in an autism support classroom within an elementary school. The paraprofessional education included a bachelor's degree and credits towards a master’s degree.

Table 1-1. Summary of demographic information for paraprofessional

	Paraprofessional
Age:	- 34 years
Gender:	-Female
Education:	-Bachelors, some Masters coursework
Work Experience:	-Para educator for 2 years
	-Worked with participant for 1 year
Placement:	-Elementary school, autism support classroom

Individual with ASD. Individuals with ASD were recruited through outreach to teachers and Speech Language Pathologists in Pennsylvania schools who worked with students with ASD and complex communication needs. To participate in the study, students had to meet the following inclusion criteria: (1) had an ASD diagnosis based on the DSM-V criteria (confirmed through assessment with the Childhood Autism Rating Scale Second Edition, CARS-2; Schopler, Van Bourgondien, Wellman, & Love 2010), (2) were ages 5-12 years old, (3) daily communication needs were not met through speech, (4) were able to follow one step directions, (5) could symbolically communicate with a minimum of 10 spoken words, signs, or graphic symbols, (6) English was the primary language used at home, (7) hearing and vision were unimpaired or corrected per teacher or parent report, (8) had limited literacy skills (e.g., not decoding).

The participant in the study was 9 years old. The participant had an ASD diagnosis, including a CARS rating of moderate. The participant was Caucasian and participated in a special-education classroom with a 1:1 paraprofessional throughout the day. His communication was characterized as fitting the definition of complex communication needs and included echolalic speech and rote phrases. Participant had knowledge of letter sound correspondence and 30 personally relevant sight words (e.g. common movies that were YouTube, family member's names). The participant with ASD had no decoding skills and was unable to read connected text.

Table 2-2: Summary of demographic information for participant

	Participant
Age:	- 9 years
Gender:	-Male
Disability:	-ASD (CARS-2: Severe)
Instruction Setting:	-Autism Support Classroom & inclusion for some subjects with paraprofessional support
Expressive Language:	-echolalic speech -rote phrases
Receptive Language:	-40 sight words -knowledge of letter-sound correspndance -Not decoding -Not reading connected text

Materials

Target Words. 15 target words were selected based on information from the teacher and analysis of academic content and PA Standards, specifically Standard Area PA.3.5.4 in the Subject Area of Earth Sciences. The target words were all related to the academic concept Landform and were selected using the following criteria; (1) Words were a 4- 8 letters in length, (2) the words could be graphically represented with photos or line drawing icons, (3) 4 of the 5 words must share an initial letter with another word in the set (e.g., cliff, cannon), and (4) the participant could not read the word correctly at baseline. The 15 target words were divided into 3 sets with 5 words per set. Each set was introduced separately, starting with Set 1. The target words in each set included the following (see Table 2-1).

Table 2-3. Word Lists, for sight word instruction

Sight Word Set 1	Sight Word Set 2	Sight Word Set 3
-marsh	-cave	-cliff
-mountain	-valley	-canyon
-plain	-volcano	-prairie
-plateau	-canal	-pond
-sandbar	-island	-iceberg

Probe Materials: Throughout the phases of the study, probes were conducted to evaluate the participant's accuracy in reading 15 words. In the probe, each target word was on a laminated text card. There was also a 2”x2” graphic symbol that was representative of the target word. Screenshots from the AAC app were taken to provide the graphic symbol.

Intervention Materials: Materials used in the intervention included an App, AAC technology, and two 15 page books created on Microsoft Word. One book included the image found on the device with one symbol per page. The other book contained the definition of the target word and an image of the word not found on the device. An example of the second book would be “An_____ is land area surrounded by water”, with an image of an island below the definition.

AAC Technology: The transition to literacy (T2L) software was used on a 12.2 -inch LCD Samsung Galaxy Tablet®[4] NOVA Chat 12 device.

AAC application with T2L software features. The T2L software features to support sight word learning was conceptualized by Light et al. (2014) to provide a first step in the transition to text from graphics-based AAC technologies /apps for individuals with complex communication needs with limited literacy skills. The T2L feature includes (Caron et al., 2018):

> Selection of a graphic symbol from the AAC grid display, enabling a dynamic presentation of text, resulting in the replacement of the graphic symbols on the screen with the written text for 3s and pairing of the text with speech output before the text shrunk back into the graphic symbol and disappeared (see Figure 1 and see the video demonstration at https://rerc-aac.psu.edu/research/r2-investigating-aac-technologies-to-support-the-transition-from-graphic-symbols-to-literacy/). The dynamic presentation took the traditionally static presentation of the written word and applied smooth movement (i.e., animation) in order to attract the learner’s visual attention to the text (cf. Jagaroo & Wilkinson, 2008), thus potentially supporting orthographic processing of the written

word. In addition, the text was paired with speech output upon selection of the graphic symbol, thus potentially supporting phonological processing of the word.

Figure 1. T2L feature, dynamic text

The generalization phase used the AAC app with a text-only grid display, that is, a static grid display with 15 written words, but no symbols. The locations of the written words within the grid were re-arranged so that none of the words were in the same location as their graphic symbol referents during intervention. Rearranging the grid ensured that the participants had to read the words to use the display; they could not rely on memorization of the location of the original graphic symbol within the grid.

Procedure

Each session was conducted for 15 minutes in a classroom by the participant's paraprofessional educator. There were approximately three to five sessions done per week. Within the same day two session could have occurred. If two sessions occurred in one day, there was a 30-minute break between each session. The four phases of the study included baseline, intervention, maintenance, and generalization. Before baseline began, training for the paraprofessional and individual with ASD occurred (i.e., trained the graphic individual with ASD to recognize the line drawings for the landforms used in the study).

Training the paraprofessional. The AAC device was introduced to the participant by a paraprofessional in a classroom setting. The paraprofessional was trained in the four phases of the study before baseline could begin. The paraprofessional was trained using instructional videos. A video explained the necessary procedures in each of the four phases and showed how to implement each phase. While watching videos the paraprofessional was given cheat sheet that they could use while watching videos and during intervention. After watching the videos, the paraprofessional took a ten-question quiz to evaluate their understanding. The paraprofessional could use the cheat sheet on the quiz. The quiz questions identified the paraprofessionals understanding on key critical components of study such as how many pictures and words to present to the participant and what to do if child gets answer wrong. The paraprofessional had to earn 100% on the quiz to begin study.

Training the graphic icons. The participants needed to identify graphic symbols for the landform vocabulary used in the study with at least 90% accuracy over two consecutive sessions. To determine the accuracy, the paraprofessional would ask the participant aloud to "point to the ____".

Baseline: The study included four phases: (a) baseline, (b) intervention, (c) generalization, and (d) maintenance. All three word sets were assessed at the same time to establish the first baseline points of each set. Once a minimum of three baseline data points with the first word set was collected and stability of the dependent variable was achieved (i.e., 2 consecutive points without an increase in slope), intervention began with the second set while set three words remained in baseline.

For the baseline probe, the paraprofessional would set out four of the landform pictures on the table in front of the participant and label them orally. The paraprofessional then gave the participant a paper with a written landform word on it and ask the participant to match the word with the picture by either pointing to the picture or handing the picture to the paraprofessional, using the prompt “give me the picture that matches this word.” The paraprofessional modeled the task of matching the written landform to the picture prior to the probe, using a word not within the 15 target words. The paraprofessional did not provide any feedback during the probe. Correct and incorrect responses were recorded on a data sheet, to get a session score out of 10.

Intervention: After establishing a baseline, the participants were introduced to the device by a paraprofessional. The device included a grid display. All 15 words (Set 1, Set 2, and Set 3 words) were included during intervention, yet only specific words from the target set had the T2L feature activate (e.g., when working on Set 1 words, Set 2 and 3 words were available on the grid and could speak, but no dynamic text was display upon selection). The paraprofessional and student read a book including all 15 words. Again, the T2L feature (e.g., dynamic text) was turned on for the target word set. When an intervention effect was established Set 1 (i.e., a score of 20% above the baseline average for two consecutive sessions), intervention with the second set began. The intervention included two parts; (a) a probe to assess the students accuracy reading the target words and (b) using the T2L feature on the AAC app to support sight word learning.

Probes: The probe at the start of each intervention session was used to measure the student's accuracy reading the target words. The baseline procedure used was the same procedure used in the probe. Intervention was terminated once criterion was reached. To reach criterion, during the probe the student got 9 out of 10 trials correct for two consecutive session. Each of the 5 words were marked on a data sheet

T2L features in AAC App: In the intervention session, the AAC app with T2L features was introduced after the probe. The paraprofessional and the student read two picture-matching books together. The paraprofessional turned the pages in the book, but did not say the target word. Book 1 did not have any text, only graphic icons, and the icons were used to elicit the selection of symbols on the device (e.g., the student selected the same symbol presented in the PowerPoint picture matching book on the grid display in the AAC app). Book 2 followed similar procedures, but included definitions with blanks and a different image of the concept (e.g., a______________ is a mountain with lava).

When the student selected the graphic symbol from the AAC system, if the word was targeted within the Set, the T2L feature was activated; dynamic text appeared from the graphic icon, staying on the screen for 3 seconds, and the text was paired with speech output. The student was then instructed to select the symbol once more to elicit the dynamic text and speech output, providing the student with two sequential exposures. The paraprofessional did not provide any feedback or focus the student towards looking at the dynamic text. This provided 4 exposures per symbol/target word three times for a total of 12 exposures to dynamic text and speech output per intervention.

Maintenance: To measure maintenance, the probe procedure used in baseline and intervention was followed. Maintenance occurred two weeks after exposure to all three sets in the intervention phase.

Generalization: During baseline and after the intervention phase, generalization data was collected to determine if the student generalized their sight word reading to a text-only grid display with to graphics or dynamic text. To determine generalization, the researcher asked the participant to “show me ___” and the researcher present the participant with a graphic icon of a landform. The researcher waited a maximum of 5 seconds for the participant to make a selection on the text-only display. This procedure was repeated for each of the 15 target words in random order.

Data Analysis

The level, trend, and slope of the data in the intervention condition were compared to those at baseline to determine the effectiveness and efficiency of the app with T2L software features (i.e., dynamic text appearing upon selection of a graphic symbol with speech output labeling the text). Non-overlap of all pairs (NAP), defined as the proportion of non-overlapping data between phases (Parker & Vannest, 2009), was also calculated. Parker and Vannest (2009) provided tentative NAP ranges for effect size: weak effect ranging from 0 to .31, medium effect ranging from .32 to .84, and large or strong effects ranging from .85 to 1.

Chapter 3

Results

Results for participant's correct responses across three word sets are presented below. The results are presented per word set across three phases (baseline, intervention, maintenance). Within each word set (Set 1,2,3) the participant's baseline was low and stable across each set. In the intervention stage, within each word set, the participant's correct responses increased. Across each set, generalization to the text-only display, as well as maintenance was seen.

Set 1 Performance

Figure 2 displays the percentage of 5 academic words (Set 1 – marsh, mountain, plain, plateau, sandbar) identified correctly across baseline, intervention, and maintenance. Probes included ten trials for the dependent variable from the set of target academic words, each word presented twice. A stable baseline was established over three consecutive sessions. The mean percent accuracy for Set 1 baseline was 36% (range of 30% to 40%). The Set 1 percentage of accuracy in the intervention phase was 73% (range of 38% to 100%). Set 1 had an increase of +37% correct after exposure to the T2L feature (see Table 3).

	Average Baseline Data	Average Intervention Data	Average Gain Score
Set 1	37%	74%	+59%
Set 2	33%	86%	+79%
Set 3	28%	90%	+86%

Table 3-4. Percentage gain score from intervention to baseline

Set 1 criterion was reached after seven intervention sessions, including 28 exposures, for a total of 1 min and 24 s of word exposure (see Table 4). In Set 1, the participant demonstrated a change in level and increase in trend from baseline to intervention. The participant in Set 1 demonstrated low levels of accuracy in baseline. There was a large increase in level of accuracy from baseline to the end of intervention (see Figure 2). There is a pronounced slope change in the intervention stage. The slope in the intervention stage compared to the baseline stage determines the effects of instruction. The slope in baseline stationary. The slope in the intervention phase is increasing. The slope in maintenance phase is increasing from 90% on the first maintenance probe to 100% on the second maintenance probe. NAP for Set 1 is 0.9762.

Word Set	Total # of Intervention Sessions	Total # of Exposures per word	Total of Exposure Time per word
Set 1: marsh, mountain, plain, plateau, sandbar	7	28	84s (1 min, 24 sec)
Set 2: cave, valley, volcano, canal, island	7	28	84s (1 min, 24 sec)
Set 3: cliff, canyon, prairie, pond, iceberg	5	20	60s (1 min)

Table 4-5. Number & seconds of exposure per word

Set 2 Performance

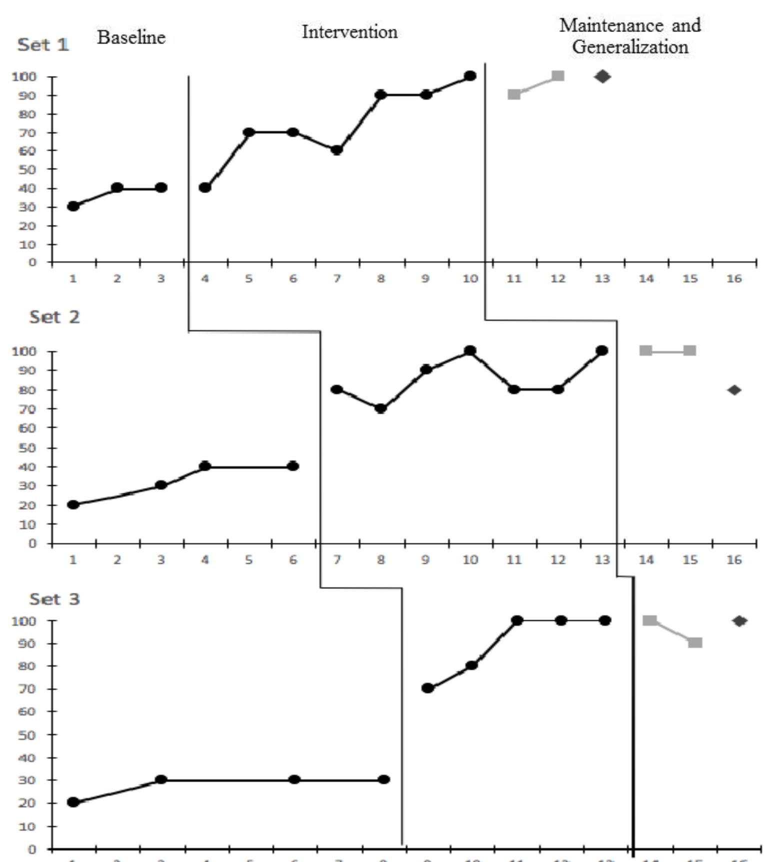
Figure 2 displays the percentage of 5 academic words (Set 2 – cave, valley, volcano, canal, island) identified correctly across baseline, intervention, and maintenance. A stable baseline was established over four consecutive sessions. The mean percent accuracy for Set 2 baseline was 32% (range of 20% to 40%). The Set 2 percentage of accuracy in the intervention phase was 85% (range of 70% to 100%). Set 2 had an increase of 53% correct after exposure to dynamic text (intervention) (see Figure 3). Set 2 criterion was reached after seven intervention sessions , including 28 exposures, for a total of 1 min and 24 s of word exposure (see Table 4). In Set 2, the participant demonstrated a change in level and increase in trend from baseline to intervention. The participant in Set 2 demonstrated low levels of accuracy in baseline. There was a large increase in level of accuracy from baseline to the end of intervention (see Figure 2). There is a pronounced slope change in the intervention stage. The slope in the intervention stage compared to the baseline stage determines the effects of instruction. The slope in baseline stationary. The slope in the intervention phase is increasing. Three maintenance probes were conducted after the participant reached criteria for Set 2. The slope in maintenance phase is 100%. Nap for Set 2 is 1.

Set 3 Performance

Figure 2 displays the percentage of 5 academic words (Set 3– cliff, canyon, prairie, pond, iceberg) identified correctly across baseline, intervention, and maintenance. A stable baseline was established over four sessions. The mean percent accuracy for Set 3 baseline was 28% (range of 20% to 30%). The Set 3 percentage of accuracy in the intervention phase was 89%

(range of 70% to 100%). Set 3 had an increase of 62% correct after exposure to dynamic text (intervention) (see Table 3). Set 3 criterion was reached after five intervention sessions, including 20 exposures, for a total of 1 min of word exposure (see Table 4). In Set 3, the participant demonstrated a change in level and increase in trend from baseline to intervention. The participant in Set 3 demonstrated low levels of accuracy in baseline. There was a large increase in level of accuracy from baseline to the end of intervention (see Figure 2). There is a pronounced slope change in the intervention stage. The slope in the intervention stage compared to the baseline stage determines the effects of instruction. The slope in baseline stationary. The slope in the intervention phase is increasing. Three maintenance probes were conducted after the participant reached criteria for Set 3. The slope in maintenance phase is decreasing from 100% on the first maintenance probe to 90% on the second maintenance probe. NAP for Set 3 is 1.

Figure 2. Percentage of Sight Words Identified Correctly



Chapter 4

Discussion

The purpose of this study was investigate the effects of the T2L feature on the acquisition of 15 academic sight words, by one individual with ASD and CCN. AAC systems can be used to capitalize on content specific literacy and vocabulary skills. A functional relationship between the dependent variable (accuracy of academic sight-word learning) and independent variable (transition to literacy software feature) was observed through the study. This study provides preliminary evidence that redesigning AAC apps to include T2L features may positively impact the sight word reading, including academic sight words, of individuals with ASD and complex communication needs. The exposure to the AAC app with T2L software features resulted in strong effects on reading performance (NAP greater than .85) (Parker & Vannest, 2009), with NAP calculations resulting in 98% non-overlapping data for Set 1, 100% for Set 2, and 100% for Set 3. Moreover, the participant learned to recognize the targeted sight words in 20 to 28 exposures of 3 s each, per word.

Sight Word Learning

Rasinski and Padak (2008) reported that, “learners of average intelligence require approximately 35 exposures to a word before it can be easily recognized; less able learners will require about 55 exposures to a word before it can be recognized automatically” (p. 169). The participant in this study learned to recognize the targeted sight words in 20 to 28 exposures to the AAC app with T2L software features, indicating the T2L features support better sight word reading results. Similar results have been observed with older individuals with ASD and CCN.

Caron and colleagues (2018) found that the T2L feature increased accuracy in sight word reading for five individuals with ASD and CCN. The five participants in this study learned to recognize the targeted sight words in 20 to 32 exposures to the AAC app with T2L software features. In both studies, the participants were able to generalize their learning to a text-only AAC display – demonstrating the transition from graphic-based AAC display to a text-only AAC display with 12 or 15 words, a significantly more difficult task.

Sight word instruction is the most common literacy intervention provided to individuals with severe disabilities (Browder & Xin, 1998). Yet, limited research includes literacy intervention for individuals with ASD and CCN (Spector, 2011). From 1980 to 2009, Spector (2011) reviewed single-subject research for sight word instruction with individuals with ASD. Spector (2011) found only nine single-subject sight word studies for individuals with ASD. Of the nine, six of these studies included individuals with ASD without CCN; including instructional and/or assessment tasks that required spoken responses (e.g., Birkan et al., 2007; Collins & Stinson, 1994; Kamps et al., 1990; Ledford, Gast, Luscre, & Ayres, 2008; McGee, Krantz, & McClannahan, 1986; Mechling, Gast, & Langone, 2002). The sight words selected for interventions most commonly included objects that were easy to represent in pictures (e.g., keys, food items, clothing) (Fossett & Mirend, 2006; Hetzroni & Shalem, 2005, Van der Meer et al., 2014) and only one study included words from "high-frequency" lists (e.g., Dolch Words) (Crowley et al., 2013). No studies included words based on general curriculum learning standards. Based on the pilot study results, the T2L features integrated into an individual's AAC system had the potential to support word learning related to the student's academic curriculum.

Changes in General Curriculum

As prevalence rates for ASD continue to increase (Center for Disease Control, 2014) and mandates for access to the general curriculum for all students (Erickson, Hanser, Hatch & Sanders, 2009) intensify, there is a critical need for teachers and researchers to develop and identify ways for individuals with CCN to make progress and positively change current low literacy outcomes. Students who use AAC must be involved and have access to general curriculum therefore; instruction must be adapted to meet their needs. This study contributes a new way to promote adapted instruction using an AAC system to access curriculum. An individual's AAC system can be used to capitalize on content specific literacy and vocabulary skills. Changing the AAC system's software to promote literacy and vocabulary skills can encourage participation in the general curriculum.

Spooner and Browder (2006) noted that access to the general curriculum is not synonymous with inclusion and that students in all types of education settings must have access to their statues' general curriculum. In this study, vocabulary words were selected based on state general curriculum standards, specifically Standard Area PA.3.5.4 in the Subject Area of Earth Sciences. This standard requires students to know basic landform knowledge and identify various early structures (e.g., mountains, valleys) (pdesas.org). Using grade level material in this study gave the participant access to the general curriculum material that his peers were learning as well. The study chose to incorporate the instruction of a science concept, specifically landform words due to its appropriateness for grade level and the words were new and unfamiliar to the participant. Despite benefits for inclusion of personally relevant and motivating words for individuals with ASD (Light & McNaughton, 2013), the study extends the sight word research indicating that the T2L feature has the potential to assist in learning of academic related sight words.

Clinical Implications

Material considerations. Photographs or line drawings are often used within sight word instruction. These graphic symbols are often paired with, presented environmentally (e.g., a line drawing of a door paired with a text label "door," taped to the classroom door), presented within worksheets, or presented within AAC systems. Yet, careful consideration of how materials are used, has the potential to positively impact sight word learning. Fossett and Mirenda (2006) stated, "…the issue is not whether or not to use pictures when teaching sight word reading skills…the issue appears to be how to use pictures effectively to teach sight word recognition…" (p. 426). The results of this pilot study suggest a change in how graphic symbols and text are used within an AAC system. To support sight word acquisition, minor changes to the AAC system seem to have the potential to impact learning. Specifically, the dynamic text (as opposed to static text) with paired speech output, appearing from the graphic symbol and momentarily replacing the graphic-based grid display, supported acquisition of 15 sight words for the participant in the study.

Intervention considerations. The individual in this study received no literacy instruction on the target words, thus isolating the AAC app with T2L features as the independent variable. However, the app was introduced in a teacher directed and very structured manner in this study, not through exposure during daily communicative interactions. In this study, instruction of sight-word learning using the T2L software was implemented by a paraprofessional during a language-learning center. Currently, the results from this study and Caron and colleagues (2018), suggest that at the very least, the T2L feature could be used in a structured centers-based approach to learning. Whereby, the device's T2L features are turned on during a specific time-period, with specific words as the focus for intervention. This format capitalizes on the visual cognitive processing benefits for individuals with ASD (Wilkinson & Jagaroo, 2004). Research has stated that actively pairing text with icons instead of static pairing will enhance word learning (Fossett & Mirenda, 2006). The simplicity of the software changes allow for easy management and utilization by different. Instructors included teachers, paraprofessionals, and family members. The T2L's minor changes do not change the software structure already on the AAC device. T2L is incorporated into the grid display already present on the AAC device. Since the software change is integrated into the AAC device, it is easy to manage by those familiar with the student's AAC device.

The T2L feature is designed to supplement, not to replace, literacy instruction. Future research is required to investigate the effects of the AAC app with T2L features when used in conjunction with literacy instruction. The design of the T2L feature provides the option of integrating literacy supports into meaningful communication, providing increased opportunities for functional learning and potentially exposing individuals with complex communication needs to relevant text throughout the day (Light & McNaughton, 2015); however it is possible that the T2L feature will present a distraction either for the individual with complex communication needs or for the partner when used during daily interactions.

Limitations

This study provides important data on the effects of an AAC app with T2L software features (i.e., dynamic text with speech output upon selection of a graphic symbol) on the sight word reading of one individual with ASD, complex communication needs, and some basic literacy skills. However, the study does have a number of limitations that should be considered when interpreting the results: (1) the study only includes one child with ASD and complex communication needs, therefore, future research is required to investigate the effects with additional individuals with ASD and complex communication needs, as well as with individuals with other disabilities; (2) the study established experimental control to determine the effect of the AAC app with T2L software features on the acquisition of the target words, however, baseline, generalization, and maintenance phases did not include five data points. The number of data points were limited to find a balance between methodological rigor and participant needs (Light & McNaughton, 2015). Findings, especially generalization, would have been strengthened if the probes had included a minimum of five data points per phase as recommended by Horner and colleagues (2005; 2010); (3) the study only focused on an isolated skill – sight word reading – with a small set of academic target words, future research is required to investigate the effects the T2L features with larger word sets as well as the effects on other literacy skills (e.g., decoding); (4) the probe tasks for all phases used a closed set of choices, simplifying the reading task (Barker et al., 2012). It is possible that performance would vary if the probes included: an increased array size, more foils with the same initial letter as the target word, and foils that were not included in the intervention. Although the results for the generalization to the text-only grid display are promising, future research investigating these areas is warranted; (5) the individuals in this study received no literacy instruction on the selected words, thus isolating the AAC app with T2L features as the independent variable.

Future Research

The results of this study suggest future research to strengthen the findings. More data would strengthen the validity of the results and better understand the effectiveness of the intervention. Extending the research to include more participants would help to generalize the results. In addition, more research should include vocabulary words across different domains of student's lives. This study only considered sight-word learning for academic words but emerging research is demonstrating the effects of the transition to literacy (T2L) feature (Light et al., 2014) on a variety of sight word vocabulary (Caron et al. 2018; Holyfield et al. 2018; Mandak et al., 2017).

Learning to read is not an isolated skill, therefore future research should include incorporating other reading instruction skills. This study focused solely on sight-word instruction. Future research should incorporate other areas of literacy instruction and knowledge to build on student's overall literacy. The AAC system redesign should not replace literacy instruction but be used as a supplement. Adapted literacy instruction through the AAC device should complement one another to enhance student's literacy skills. Future research is required to investigate the effects of the AAC app with T2L features when used in conjunction with literacy instruction.

Conclusion

Changes in federal policy have promoted a new emphasis on teaching academic content to all students, including those with severe disabilities (Delano, Otabio, & Whalon, 2010). These students must have access, be involved, and progress in the general curriculum, and therefore, instruction must be adapted to meet their needs. Results from this pilot study support that dynamically presenting text, paired with speech output, upon selection of a specific graphic symbol in a device, can improve sight word learning. Providing preliminary evidence that with minor AAC systems design changes, AAC systems could potentially be used to foster fuller participation in the general curriculum – promoting both communication and literacy learning.

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ACADEMIC VITA

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Education:

The Pennsylvania State University: University Park, PA

• B.S. Communication Sciences and Disorders
• Special Education Minor
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Thesis Title:
• EFFECTS OF GRID BASED AAC APPS TO SUPPORT ACADEMIC SIGHT WORD LEARNING IN INDIVIDUALS WITH ASD

Thesis Supervisor:
• Dr. Jessica Gosnell Caron

Research Experience:

Penn State Department of Hospitality Management
Research Assistant for Dr. Peter Bordi

- Collaborated with Penn State Researcher Dr. Bordi to develop a drink that was satisfying and would help nullify the effects of radiation and chemotherapy.
- Evaluated texture, flavor, and key ingredients for the drink to provide relief for patients experiencing sore throat, lethargy, and weakened immune systems
- .Investigated the effects of vitamin and minerals within the human body. Investigated the vitamins, minerals, and nutrients necessary for patients receiving treatment.

Penn State Department of Communication, Sciences, and Disorders
Research Assistant for Dr. Erinn Finke

- Worked with Penn State Communication Sciences and Disorders professor, Dr. Erinn Finke on investigating interaction between individuals with Autism while playing video games.
- Assisted in recruitment of participants with and without Autism as well as recruit Speech Language Pathologist, educators, and other professionals who worked with individuals with Autism.
- Primary role was to transcribe video recorded interactions of participants and provide a written transcription help evaluate the semantics among the participants.

Penn State Department of Communication, Sciences, and Disorders

Research Assistant for Dr. Jessica Gosnell Caron

- Investigate the supports required to provide adaptive literacy instruction for students with Autism Spectrum Disorder who use Alternative and Augmentative Communication (AAC) to supplement my honors thesis.
- Work closely with Dr. Jessica Caron and Master's Students in Communication Sciences and Disorders.
- Create personalized storybooks for each client that are interesting to read and include key vocabulary words to use in the instruction plan. Upload and create an interactive storybook with dynamic text and auditory output using the Snap Scene App.
- Observe in the clinic to learn how the storybook interaction is taught and make suggestions on how to improve the books as well as instruction using the device.

Employment Experience:

Summer Camp Counselor-Head Counselor

Hanover Township Community Center, Bethlehem PA

- Plan a comprehensive 12 week summer schedule including activities, arts and crafts, and games that relate to weekly themes.
- Train counselors, assist in understanding their role, and provide support when questions or concerns arise. Serve as primary contact between parents and the camp program.
- . Responsible for the safety and enjoyment of the campers throughout the summer and build relationships with the campers and coworkers to serve as a role model for them.

Morgan Academic Center Student Athlete Tutor

Penn State University

- Develop overall understanding of student's courses and teach student athletes study-skills to use in the classroom.
- Host weekly individual or small-group sessions to review course material to help better conceptualize the information as well as teach study strategies in preparing for exams.
- Provide tutor services for a variety of courses including humanities, science, education, and social science amongst a range of athletes at each academic level.

Leadership Experience:

Penn State Track and Field Club

President 2017-2018 School year

- Lead a team of 100+members through daily practices, facilitate events and community service projects, preside over meetings, manage inner workings of team, and plan track meets.
- Collaborate with the governing body of Penn State Club Sports to ensure compliance with protocol, processes, paperwork completion and club duties.

- Work closely with 9 other executive board members to promote an enjoyable environment and experience for all members.

Penn State Fresh Start Leader

Penn State University

- Introduce new students to the opportunities to serve the community at Penn State Fresh Start, the largest day of community service for first year and transfer students.
- Facilitate friendships between new students, encourage engagement in the Penn State community, and answer questions and give advice to new students as they transition into college.
- Motivate the students and instill the importance of serving the community in hopes they will continue to engage in service throughout their time at Penn State.

Penn State JumpStart Leader

Penn State University

- Served as a student leader for Penn State's College of Health and Human Development JumpStart program, run by faculty and staff in the college of Health and Human Development to help first year students adjust to college
- Attended training meetings, brainstormed activities used to benefit new students relating to study habits, coping mechanisms, and tips on attending a large University.
- Engaged new students during camping trip through activities, answering questions and establishing a support system.

THON Volunteer

Penn State University Dance Marathon

- Conducted fundraising activities throughout the year as well as help to organize and work fundraising events to support THON, the Penn State Panhellenic Dance Marathon, a 46 hour dance marathon run by Penn State University students.
- Focused efforts on the goal of THON to provide monetary and emotional support for families of the Four Diamonds Fund with children undergoing cancer treatment at Hershey Medical Center.
- Selected this past February 2017 as one of 800 students to dance in THON. Danced for 46 hours to celebrate with my peers and the families of the Four Diamonds Fund.

Teaching Assistant

CSD 269-Deaf Culture

NURT251-Introductory Principles of Nutrition

- Collaborated with fellow teaching assistants and professors to problem solve and assist in classroom responsibilities.
- Graded student projects, answered questions, assisted with record keeping, and proctored exams.
- Held weekly office hours to answer student questions and clarify concepts taught in class.
- Work as a mediator between the students and professor. Created review sessions that were held outside of class to help students prepare for exams.