EFFECT OF ADAPTED PHONIC FACES STORY BOOKS ON PHONOLOGICAL SKILLS
OF CHILDREN WITH SEVERE EXPRESSIVE LANGUAGE DISORDERS

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DEDICATION

This document is dedicated to the memory of my mother

Dr. Maneck Pavri

For her encouragement and belief in my abilities

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ABSTRACT

Although No Child Left Behind (2001) encourages the inclusion of all children within the regular curriculum, children with severe speech and physical disabilities rarely are provided with the literacy education provided to grade-level peers. This study taught alphabetic skills to three children with severe speech and physical impairments in the context of traditional alphabet books versus Phonic Faces Storybooks. Both storybooks were converted into e-books using Microsoft Office PowerPoint (Microsoft Office, 2003) and accessed using a single rocking lever switch. Two graphemes were selected based on incorrect responses from the pretest administration of the *The Phonological Awareness Test* (Roberson & Salter, 1997). The three subjects were exposed to the target graphemes using an ABAB design where the treatment conditions were reversed following the second baseline period. Five probes assessing phonological and grapheme awareness skills for targeted graphemes were administered following each baseline and intervention session. Results revealed greater improvements on letter/sound identification, sound to letter identification, identification of letter names, and identification of location of letters and sounds in all word positions words for all three subjects during the Phonic Faces Storybook phases. Improvement was also seen in the pre and posttest scores on seven subtests (rhyming, deletion, substitution, isolation, segmentation, blending and graphemes) of *The Phonological Awareness Test* (Roberson & Salter, 1997) and on word recognition, and silent and oral reading on the *Informal Reading Inventory* (Burns & Roe, 2006). Anecdotal evidence also demonstrated eagerness to work on the computer, preference for Phonic Faces e-books vs. alphabet books, and an increase in speech production (imitation of speech sounds). Limitations of the study, which include a small number of subjects and use of a small number of sounds needs to be addressed in future research studies.

INTRODUCTION

Children with severe speech and physical disabilities face a greater challenge than their peers when attempting to learn literacy skills. Learning to read an alphabetic written language in part requires children to learn that one symbol system (e.g., letters) refers to another symbol system (e.g., phonemes), both of which are elements of the phonological aspect of language. Children with severe speech and physical disabilities have limited opportunities to organize expressive phonological information in any modality. Understanding symbolic thought and language provides a framework for recognizing and compensating for the challenges faced by these children as they attempt to acquire written language.

Language, whether spoken or written, is a complex symbolic system. To understand language, an infant must develop the ability to mentally represent objects, states, and actions and then to refer to the mental representation with an arbitrary symbol such as a spoken or written word (Bates et al., 1979). An infant must begin this daunting task equipped only with sensori-motor reflexes and the amazing ability to cognitively construct and refine internal structures that represent experience. The journey from reflex to symbolic thought is accomplished in just two short years. The symbols of the 2 year old become ordered, parsed, categorized, and synthesized during the period from 2 through 7 years. It is during this time that children master the complex operations of grammar and also learn to read. Perhaps more than any other theorist, Piaget (1952) provided insights and a theoretical model that helped conceptualize the process of change from birth to early childhood and beyond. Examining Piaget's first two stages of development, sensori-motor and preoperational, can provide a frame for understanding the acquisition of early reading abilities.

Piaget and Symbolic Thought

According to Piaget, infants have intelligence but they do not have thought. Thought requires an internalized structure of concepts that can be combined, sequenced, reordered, and transformed to create something that is different from actual experience. During the period from birth to 2 years, children begin to form mental representations, or the ability to hold a mental image in mind after the original stimulus is gone. By the end of this stage of development, the ability to use a symbol, such as a word, object, drawing, or image to refer to mental representations emerges. With this advancement, the child is able to manipulate the symbols in the absence of the objects, resulting in the ability to think. While a powerful cognitive tool, thought for the 2 year old has many limitations that are only gradually overcome as children progress through preoperational and concrete operational thinking until hypothetical thought is achieved at adolescence with the emergence of formal operations.

Piaget (1952) theorized that children learn through action, beginning at birth with sensori-motor action. As the infant grows, the capacity for organized sensory and motor actions increases. The infant moves from a "practical, perceiving and doing, action bound" to a more "contemplative, reflective and symbol-manipulating" kind of intellectual functioning (Flavell, Miller & Miller, 2002, p. 64). The sensori-motor stage starts at birth and continues until age 2 years. During this stage (which is further subdivided into six sub-stages) the child's thought changes as representational abilities are acquired.

Reflexes form the crux of the first sensori-motor sub-stage, which occurs from birth to six weeks of age. These reflexes are the first sensori-motor schemes of the infant. Some of these reflexes change little with age (e.g., the sneeze reflex) whereas others come under the control of the nervous system and are integrated (e.g., asymmetrical tonic neck reflex) or disappear

completely (e.g., Moro or startle response). Reflexes such as sucking, tracking (eye movements), and movements of the hand and arm are of great importance developmentally. When applied to more objects and events they become assimilated into experience-based schemes. Gradual change (or accommodation) occurs as a result of these new experiences (Flavell, Miller & Miller, 2002). Changes result in the development and elaboration of the reflexes, which start coming in control of the infant (e.g., the palmar reflex turns into intentional grasping) (Gruber & Vaneche, 1977).

Also during this sub-stage, (Piaget, 1954) the infant recognizes and anticipates familiar recurring objects associated with events such as feeding, and responds towards them with mouth, hand, eye, and other sensori-motor actions. As these responses later become more predictable, the infant is able to organize actions to produce the reactions in a more systematic and adaptive manner when the stimuli appear. In this manner the child assimilates the external data to create internal mental schemes and accommodates (makes changes) to these internal mental schemes according to changes in the external world. The assimilation and accommodation of reactions results in modification and elaboration of internal schemes.

Children with severe speech and physical impairments are at a distinct disadvantage for developing schemes from the beginning of infancy. Although they are able to recognize and anticipate recurring and familiar events; they are unable to react to them with hand, mouth, eye and other body parts (McNaughton, 1993). Persistence of abnormal reflexes (asymmetrical and symmetrical tonic neck reflexes) prevents coordination of eye and hand movements. These reflexes prevent children with disabilities to bring objects to their mouth. Unable to manipulate and explore objects, these children are at risk for development of resultant learning schemes (McNaughton, 1993).

During the second sub-stage (which occurs from six weeks to four months) individual schemes (with repeated practice during daily routines) become more elaborate and attuned to the environment, resulting in the formation of habits. Primary circular reactions also begin at this stage. These reactions involve repetition of actions that involve the infant's own body (e.g., repeated motion of passing their hand in front of their face). With each repetition the scheme is refined and elaborated. However, the child is still at an egocentered stage where objects must be brought to the child rather than the child seeking out objects to act upon (Flavell, Miller & Miller, 2003; Gruber et al. 1977).

In typically developing children, once developed, schemes can be combined to form larger and more elaborate schemes (Piaget, 1952) such as coordination between vision and prehension resulting in purposeful grasping for a desired object. Elaboration of schemes occurs most likely in the third sub-stage of the sensori-motor development, which extends from four months to eight months of age. In addition to elaboration of schemes, secondary circular reactions (or repetition of an action with an object) are also observed (e.g., turning a light on and off repeatedly with a switch) (Gruber et al. 1977). The child, who is now beginning to decenter, can attend to and act upon an object that is in close proximity. Another hallmark of this stage is the differentiations between ends and means. It sets the stage for the beginning of logic needed to plan a means to achieve a goal (Gruber et al. 1977).

The fourth sub-stage that occurs from nine to twelve months marks the beginning of planning, development of logic and coordination between means and ends. The child exhibits goal-oriented behavior in that he demonstrates deliberate planning of steps to meet an objective (e.g., use of intentional gestures and word approximations to get what is wanted). Piaget calls this stage as the sign of "first proper intelligence" (Gruber et al.1977). In order to plan, the child

must have an internal mental representation of the action and understand the resulting consequences before they occur (Flavell, Miller & Miller, 1977).

During the fifth sub-stage, which occurs from twelve to eighteen months, the child combines schemes mentally to discover new means to meet goals. The use of repetitive circular schemes is now replaced with the use of several different schemes and the ability to combine them in novel ways to explore objects. This stage is also characterized by active, trial and error exploration. Piaget describes the child during this stage as the "young scientist" conducting small experiments to discover new ways to solve problems (Gruber, et al. 1977).

Once again we find that children with speech and physical impairments may experience obstacles or restrictions during the development of elaborate schemes. Lack of success at reaching, grasping and manipulating objects puts them at a disadvantage for developing the intrinsic motivation to further explore toys and objects. Although initially children with disabilities may be interested in novel and diverse stimuli, their inability to respond appropriately and independently explore these stimuli further results in the lack of interest in toys and objects and a passivity towards external stimulation (Gossens', Crain & Elder, 1993). Yet many of these children have good cognitive and receptive abilities, indicating that schemes are capable of forming through observation.

The sixth sub-stage of the sensori-motor stage holds the most significance to the development of symbols. It is in this stage that the infant demonstrates the ability to use a mental image (a word) to stand for something else (object). The child is able to go through possible solutions internally and produce a possible correct solution. The child is now capable of deferred imitation (actions are not repeated immediately but acted out in completion at a later

time). Pretend or symbolic play makes its first appearance in this stage. Each of these new abilities is made possible through symbol usage.

Children with severe speech and physical impairments (who are unable to physically manipulate objects and toys in order to independently arrive at conclusions) are at a risk for the development of appropriate mental representations and reference through symbols. They may be unable to imitate adult actions and apply deferred imitation to discover the outcome. Pretend or symbolic play is at most times impossible for children with disabilities who therefore appear to be at risk for symbolic development (Musselwhite & King-DeBaun, 1999).

<center>Preoperational Thought</center>

The emergence of symbols marks the transition to a new type of intelligence, where representations such as words enable objects to exist in thought even when not present. Thinking at this level becomes increasingly more decontextualized in time and space from the actual event and new types of cognitive organization such as categorization of objects emerges. However, thought during this stage has many limitations, which is why Piaget named this stage of development "preoperational." The beginnings of operational thinking are present during this time, but children cannot conserve, reverse, or think from a perspective other than their own. They still learn from concrete evidence and make judgments based on appearance rather than on mental operations. Piaget referred to this as egocentric thought and language.

Preoperational thought is characterized by centration, or a focus on only one dimension of an event. Piaget showed how children were unable to conserve things such as identical quantities of liquid poured into different sized containers because they could only focus on one dimension of the containers.   Similar limitations are seen in alphabet knowledge. Children in this stage begin to learn the alphabet and name many letters and perhaps even their sounds.

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They also become aware that there are words, both in speech and in writing and can point to words by late 4's. But it is not until fairly late in preoperational development, between 5-5.6 years, that they begin to understand the relationship between sounds within words or letters within print, and can point word-by-word to sentences as they are read. This type of phonological awareness begins to emerge at about 4 years but takes a long time to be fully realized, with many aspects not present until the end of preoperational development at age 7 (see Norris & Hoffman, 2002 for a developmental chart).

Serialization emerges during pre-operations, as demonstrated by the ability to arrange things in order according to properties such as size, shape, or gradients of color. But transformations cannot be performed, such as mentally reversing the order or inserting a subset within the series. Similar skills and limitations are seen in phonological awareness. Children with literacy experience begin to blend CVC sounds to form words between 5-5:6 years, but can't delete sounds mentally to form a new word or manipulate sounds at the beginning and ending of words until 6-7 years.

Another accomplishment of preoperational thought is the ability to classify or group things by an abstract dimension such as color (things that are blue even though they have no other similarity), function (clothing, transportation), or class (animals versus objects). However, classification is limited to one dimension, so that children cannot classify "big blue" objects accurately when choices include small blue, big red and green objects and so forth. Similarly, children begin to name letters at 4 years but do not associate them with sounds accurately until 5-5:6 years, and cannot coordinate letters-sounds-words to sound blend until 6-7 years. Sound blending requires hierarchical classification, where a letter simultaneously is classified as associated with a sound and a word.

Piaget provided insights into the emergence of symbolic thought and the advances and limitations of symbol usage for children between the ages of birth and 7 years. Other researchers have shown that children with speech and physical impairments are at-risk for delay or for fully developing these mental structures. These delays or deficits leave children who are AAC users particularly vulnerable for failure to acquire written language.

Written Language Symbols

Written language, like oral language, is a symbolic language system. This symbolic system emerges along a continuum of representation in much the same way as oral language symbols. During the 2nd year of development, children with frequent literacy experiences learn that print communicates. Their knowledge of print is holistic and undifferentiated. That is, children begin to recognize letters as whole objects rather than as parts of words, and they begin to recognize that adults read words in books without knowledge of the specific words or orthography (Clay, 1991). But by the end of preoperational development, children begin to respond to print operationally, coordinating the parts, or letters, within the whole, or words. They have constructed a hierarchical organization of letters, sounds, and words that can be accessed for tasks related to phonological awareness or decoding. They can understand that a written symbol can simultaneously be classified as a letter and as part of a word (hierarchical classification), and that letters can be combined to form a word as well as that a word can be segmented into parts (reversibility, conservation). In this manner, letters and words conform to the same operational logic as other objects (Piaget, 1952).

Early experiences with letters involve concrete objects. Children from literacy-rich environments manipulate pencils, crayons, magnetic letters, blocks, computer games, and other alphabet toys. The letters become concrete objects that can be moved, ordered, transformed, and

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named before they become true mental symbols representing sounds. The experience of sequencing, reordering, and making sense using letters has a well-established foundation in concrete, sensory actions with letters (Clay, 1991, Fein, 1993, Goodman, 1986).

During book reading, initially a 9-month old infant will pat and rub pictures as if they are objects and even try to pick them off the page (DeLoache, Pierroutsakas, Uttal, Rosengren & Gottleib, 1998). However, by age 19 months, children are able to find the similarity between the actual objects and their pictorial representations. By 4 years of age however, children are able to understand that pictures are representations of the real object because of the viewer's intent to make it representational (Bloom & Markson.1998). Children can be convinced to call two similar drawings one of a lollipop and another of a balloon to represent the real objects when they are given a label by an adult (Flavell, Miller & Miller, 2002).

Children with poor speech and motor skills again may experience difficulty while manipulating objects that promote literacy. They are usually unable to hold and use writing implements such as crayons and markers (Musselwhite, Erikson & Zialkowski, 2002). They are also unable to manipulate blocks, magnetic letters and other toys so as to be able to independently construct meaning out of these manipulations. This lack of physical experience might impact their learning from their environment from early infancy (Gossens', Crain & Elder, 1993). They therefore need to construct their knowledge through visual, auditory, and limited tactile experience. They lose the opportunity to experiment, and must construct knowledge of the physical, social, and symbolic world through the actions of others, often well-formed adult actions (adults don't engage in random, exploratory play or manipulation of letter symbols to learn about their physical properties). Infants and young children can create internal schema for many objects, actions, and states from observing others. However, these observed experiences

are qualitatively different from those children typically experience as they develop. Observed experiences show that children with poor speech and severe motor disabilities can comprehend text when it is read to them however, they are unable to comprehend text when asked to engage in silent reading tasks (Koppenhaver & Yoder, 1993). They have difficulty with blending sounds to form words and to reorder letters to form different words (Foley, 1993).

Children with disabilities usually are unable to reach and touch pictures in a book and/or manipulate print based materials adequately and independently (Erikson, Koppenhaver, & Yoder, 2002). Turning pages of book or even patting pictures on the pages of a book is often too laborious or an impossible motor movement for these children to accomplish. Lack of ability to use speech to respond to adult communication prevents children with severe speech impairments to demonstrate their understanding of concepts, pictures and objects. They are usually unable to repeat labels used by adults or to comment, ask questions, provide feedback (Koppenhaver & Yoder, 1993).

Thus, while adults may provide experience with print, it's different in both qualitative and quantitative ways. Children with severe speech and physical impairment miss opportunities for book handling, or discovering the nature of the print. They are unable to incidentally cover the text only to discover that the adult stops reading, thus realizing that those lines and shapes have meaning to the adult (Musselwhite & King-DeBaun, 1997).

<center>The Alphabet as Semiotics</center>

The distinction between symbols is one level of sign where a direct versus an indirect link between a letter and its associated sound is an important one when the manner in which the mind uses symbols is considered. Semiotics refers to the use of signs within a society. Originally discussed by Saussure (1955) in his theory of language, it was elaborated by Pierce

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(1971) who also changed the original use of the words "sign" and "symbol." Modern theorists conventionally use Pierce's terminology. In semiotic theory, signs are events or things that direct attention or indicate other things. A directional point, eye gaze, written labels, words, or a leaf falling from a tree all may be interpreted as signs. In Pierce's terms, these are the signifiers. The interpretant, or receiver of the sign, imposes a meaning that may be similar to that of the sender (directional point results in both sharing attention at an object) or it may be very different (interpretant perceived the point to be directed at him rather than an object behind him). The representation assigned to the sign by the interpretant is the signified. The sign may have been intentional (directional point) or reflexive (a baby cry), or fortuitous (a falling feather). Anything that represents something else is a sign.

Signs represent on different levels of abstraction, with 3 categories of signs termed the icon, index and symbol. Icons are the most transparent signs, because they look like the object or event signified. A stick figure male or female icon marks restroom doors to signify the user. Street signs use arrows and other icons to signify upcoming curves or turns. A photograph is an iconic representation of an object or event. Phonic Faces use the lines of letters to signify speech production cues (the vertical line of the letter "k" is drawn as an elevated tongue; the oblique lines signify the explosion of air). There is no connection between an icon and its signified other than the likeness. To interpret the sign as intended, the interpretant must see the similarity and associate the two. The icon has the advantage of being capable of teaching the interpretant something about the signified. One may not know what nutria is, but seeing the image of one can teach information about its appearance. Similarly, seeing the letter "k" drawn as the elevated tongue with exploding air teaches something about the association between the letter, speech production, and associated sound. No other level of sign has this property.

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The index signifies through indication, and has a causal or sequential relationship to its signified. Things become linked because they occur together. Indices (or indexes) may suggest or indicate that something not directly perceivable is present. For example, a feather falling from a tree suggests a bird is in the tree. They also may indicate something internal is signified. A baby's cry may indicate hunger and thus function as an index even though hunger can't be directly seen. Pointing is another type of index, referring to the signified through indication. This level of sign is logical and contextualized. It is learned through experience and association. The greatest difference between the icon and index is the transparency. A cry does not look like hunger; a point does not look like the target object, and a letter does not look like a sound. Children may learn that a letter indicates a sound through modeling and memorization. But if the letter is not understood at a higher level of sign, i.e., the symbol, then the information is of little use. Children may name the sounds but not be able to blend them to form a word. The nature of the index is that it has nothing to do with that which is signified. It is only linked through a causal or sequential relationship. It is bound to the immediate context of use and lacks flexibility of meaning. A point to a dog signifies only that dog at this moment in time and is interpreted based on the context. Thought is limited to the here-and-now.

Children with severe speech and physical disabilities have limited access to indexes and therefore may have difficulty developing this level of sign during language learning. Abnormal reflexes (e.g., the atonic neck reflex, and asymmetrical and symmetrical tonic neck reflexes) may persist into early childhood. Coordinating eye gaze with pointing therefore may become impossible causing adults to sometimes misunderstand the children's use of indexes (or where they might be pointing). Without interaction from the communication partner to shape their

pointing and give appropriate meaning to it, these children may be unable to further develop use of signs (Burkhart, 1993).

The symbol, or the highest level of sign, is completely arbitrary. It does not look or sound like the signified, and is not linked through a causal or sequential relationship (although it may have first been learned in that manner). Words are prime examples of symbols. The word "logical" has no visual or auditory equivalent (icon), nor does saying the word serve to signify some object or event through association. Rather, it signifies something because of social convention or habit. Symbols refer internally, to concepts within the mind. They do not signify real objects or events, but rather to concepts of these objects or events. Saying the word "dog" while pointing to the dog can have a wide range of meanings and interpretations signified because the concept of "dog" is much more elaborated than the physical dog signified. Symbols can be used to combine concepts in new ways to create new concepts that are given identity when they are named (dog plus similar parents = purebred; purebred plus ancestors = pedigree; pedigree + papers = registered). From that point on, the name, or signifier, refers to that mental concept which then can be used in an infinite number of ways. The symbol is not bound to a context or an association, but can come to have infinite flexibility and productivity. Alphabetical letters are symbols. An arbitrary arrangement of lines and shapes is conventionally assigned to signify the concept of a sound that may exist within a potentially infinite number of words. A sequence of letters that conforms to conventionally agree orthographic rules signifies a word that itself signifies a concept of an object, action, or part of speech. Like oral words, written words refer internally to concepts within the mind.

Semiotics and AAC Users

There is evidence that first words are learned as indices (Bloom & Lahey, 1978). Early words are imitated in a specific ongoing context of use, and initially used in a very restricted manner with limited meaning. First words used by young children refer to objects and events that are salient, familiar and important to them (Nelson, 1985). First words may therefore denote family members (Mama), toys, food items (juice), body parts (eye), clothing items (shoe) and utensils (spoon). Other first words may include greetings (hi or bye), action words (go), relational words (more) and location words (here) (Gopnik & Meltzoff, 1993). These first words stand for "basic-level" categorization where the word "puppy" could stand for a small dog but also for the general category for "animal".

The restrictions often experienced by individuals with severe speech and physical disabilities that impact their natural language learning may inhibit the development of underlying language skills (Berninger & Gans, 1986; Smith, 1992). McNaughton (1993) suggests that developmental differences of young AAC users may result from their limited physical and verbal interaction with the environment. Foley (1993) suggests a number of potential contributors to language deficits for this population including the inefficiency in generation of a phonologic code orally which results in generalized language deficits as well as a difference in the language learning process. Sutton (1996) states that AAC users do not acquire language in the same way as speaking children because they are unable to produce utterances as effortlessly and in the same manner as speaking children. This claim is based on socially based communication theories (Vygotsky, 1978) in which the role of language production for social interaction is emphasized. McNaughton (1993) emphasizes the need for providing rich receptive language experiences, as well as opportunities for AAC users to construct their own words and sentences using their

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communication systems. Without the ability to produce words and early access to

communication devices, children with severe speech and physical disabilities are at a risk for

developing the use of words as symbols.

Words learned in context gain symbolic status as the child begins to see that the same

word can signify different referents in a range of contexts. The word cannot maintain the

original attachment to the signified, but rather must refer to a category or concept of the

signified. This begins to free the concept and the word from the here-and-now, as symbols

become the objects of manipulation. Only after considerable time does the word become

symbolic, used with flexibility in meaning and function. It is not until after 4 years of age that

children can separate the word from its meaning, recognizing that there is no necessary or direct

connection between the word (signifier) and what it signifies. The child understands the

arbitrary nature of the symbol when thought can perceive pure symbols (Nelson, 1985, 1996;

Clark, 1987).

Children with severe speech and motor impairments usually have limited contextual

experiences. Physical impairments may not only prevent access to a variety of environments but

also limit the ability to manipulate objects and learn their symbols within those environments

(Musselwhite & St. Louis, 1990). Their limited oral motor skills prevent them from using the

same word to represent different referents in a variety of contexts (Foley, 1993). Unless they are

provided easy access to portable communication devices that are programmed appropriately with

symbols to represent referents with a variety of environments, children with severe speech and

motor disabilities are at risk for using the word as a symbol with flexibility of meaning and

function.

Children who use AAC systems have another confound to deal with while learning words as symbols. Their communication devices are usually programmed with picture symbols that represent different concepts. They have an additional layer of conceptualization to achieve before they can interact with others. The AAC users must make a symbolic association between words heard (auditory words) to picture communication symbols on their AAC devices (McNaughton, 1993). Pictures used on the communication devices are frequently generic black and white or colored line drawings of different concrete objects. Young children who use AAC systems not only have to learn that the word "dog" refers to all types of dogs but also that the picture of a dog on their communication device refers to the same concept of the word "dog" (McNaughton, 1993). In addition, most adults and peers in their environment use speech to interact and rarely provide AAC users with a model of using a communication device for interaction (Gossens', Crain & Elder, 1992).

The most effective communication symbol system for the widest range of communicative partners is written language. Strangers who have no knowledge of AAC symbol systems can read written language. The message can be abbreviated to a telegraphic format or written in fully grammatical sentences. Many computerized programs have been developed to assist writing with features such as word prediction. However, many AAC users never reach a level of proficiency with written language that enables them to use print as a medium for learning or communication. One reason may be the differences in the internalized symbolic systems constructed by children with limited motor abilities. Understanding the complex semiotic relationship between letters, sounds, words, and concepts may be even more difficult for these children than for those who have developed these associations through more typical experiences.

The symbol is the minimal level of sign that a letter can be understood and used for reading. Pierce subdivides symbols into "singular symbols" that denote tangible things, versus "abstract symbols" that signify abstract concepts. Letters must signify abstract concepts to be understood. Memorized letters and sounds are not symbols. It is only when the letter signifies mental concepts of words and the structure of words that letters can be used to represent language. When this level of sign is attained, flexibility and productivity is present. A letter can simultaneously be viewed as a concept and as part of the concept of a word. It can be viewed as belonging to a potential infinite collection of words, in different word positions, and signifying more than one sound. It can be blended with other letters to form real words, nonsense words, or orthographic patterns. Or it can be segmented apart from words or chunked into syllables. This internal knowledge of concepts about letters, sounds, and words is linked hierarchically so that thought can move flexibly between and among them. Thus, children can readily understand the conceptual relationships between letters, sounds, words, word meaning, orthographic patterns, and other aspects of language (Blachman, 1994; Wagner & Torgeson, 1987). We recognize this as have "good phonological awareness."

For children who are developing a symbolic hierarchy of word knowledge, alphabet books and other activities that establish a relationship between the letter and familiar words beginning with the letter can bootstrap letter learning. Like first words, the association between letters and sounds can enter the system as an index, where the letter signifies the sound and associations with related words. The words with their existing hierarchical structure can provide a structure for the letters to bond. Thus, the symbolic structure of known words and their phonological structure provide a scaffold for letters. The majority of children indeed do learn the alphabetic principle through this association. But other children are not able to make these links.

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The associations between letters and sounds remain indexical. If not rehearsed, they may be forgotten or recognized intermittently. The associations with words add confusion rather than clarity. As an index, the letter can only make an association to the referent and not to the mental hierarchy needed for letters to be recognized as part of a complex structure of oral and written words.

An alternative route to learning this knowledge can be a more iconic representation of the association between letters and the child's internal structure of words, such as Phonic Faces (Norris, 2001). Instead of viewing letters as random lines and shapes with an arbitrary association to a sound, Phonic Faces (Norris, 2001) embed the lines and shapes of the letter in the mouth of a face. The lines and shapes of the letters form the lips, tongue position, voice, or sound patterns of the speech production features associated with the letter. This makes the meaning and purpose of letters concrete and transparent. There is a direct link from the visual shape of the letter to the associated sound, in that the letter is an iconic representation of speech. The traditional presentation of letters presents an indirect link. The letter is associated with pictured words that begin with that letter/sound. The child must understand that the visual letter is a symbol that stands for something associated with that pictured word. That pictured word itself does not make the sound (apples don't say /a/). Rather, the picture and all meaning must be mentally discarded in favor of the concept of a word. The mental concept of a word must be mentally segmented and only the word onset maintained in memory. Then, the visual letter symbol must be linked to the isolated onset phoneme to understand that "a" represents the /a/ sound (Norris & Hoffman, 2002).

The association of Phonic Faces letters (Norris, 2001) with speech offers a different type of bootstrap, one that links letters to oral speech that enables the associations to enter the

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internalized hierarchical structure of words. The structure of blended words also is more transparent. The child merely needs to recognize the sequence of iconic representations of sounds to actually produce the word. Once heard, the word is oral and as an oral word interest into the internalized mental structure. With repeated exposure, the printed symbols begin to be structured as an integral part of the hierarchy.

LITERATURE REVIEW

Children with limited speech production who require the use of Augmentative or

Alternative Communication (AAC) devices for communication are typically very delayed and

limited in the acquisition of reading skills (Erikson, 2003, Koppenhaver, 2001). Learning to read

with comprehension is typically a daunting process for persons who use AAC. Although many

successfully learn to read words in isolation and understand text when someone reads it to them,

estimates are that no more than 10% can read with comprehension above a second-grade level

(Koppenhaver & Yoder, 1993). In addition, most users of AAC systems also demonstrate poor

phonological awareness skills (Foley, 1999; Dahlgren-Sandberg, 2001; Vandervelden & Siegel,

2001). Few studies have addressed reading intervention for young AAC users with limited

physical abilities. The purpose of this study is to take a beginning step into answering

questions about the capacity of severely impaired non-verbal children acquiring early reading

skills. The Phonic Faces alphabet, designed to picture letter-to-sound production associations,

was compared to the traditional alphabet to determine if this iconic visualization would provide

children a useful tool for acquiring early reading skills.

Reading Difficulties in AAC Users

Despite No Child Left Behind (2001) and its mandate to teach all children to read, little

time is typically spent in teaching literacy to children who are concomitantly severely speech and

language impaired and non-verbal and who have not yet mastered oral communication skills

using AAC devices. Part of the reason for this is theoretical: many researchers view written

language to be an explicitly taught skill superimposed on an already well developed oral

language system (Teale & Sulzby, 1986). This leads to the belief that efforts need to focus on

establishing a communication mode prior to introducing literacy instruction. Family members

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and professionals have low expectations for children who use AAC devices when it comes to literacy and rate it as a low priority goal for them to achieve (Karlan, 1990). Physical challenges limit their access to literacy materials (Pierce & McWilliams, 1993).

Other reasons for the lack of literacy instruction are more logistical. It is difficult to determine what children who are non-verbal understand and what skills can be applied when reading text (Erikson, Musselwhite & Ziolkowski, 2002). The technology itself imposes limitations, both within the devices and the knowledge of the teacher and user of the AAC systems. Although dedicated AAC devices are getting smaller in size and more sophisticated, systems needed by children with limited physical abilities still remain typically bulky with little or no ability to connect to computers. Related services professionals have limited knowledge of the systems and spend most of their time learning how to program them rather than conducting actual intervention and interaction with the child. All of these issues must be addressed to improve the literacy of children using AAC devices.

While low literacy skills are typical of the majority of AAC users, literacy is a critical skill for independent functioning for both children and adults. Literacy here is used as an umbrella term, encompassing both reading and writing (Koppenhaver & Yoder, 1993). Reading is a complex process that requires the coordination of interrelated sources of information and involves constructing meaning from written texts (Anderson, Scott & Wilkinson, 1985). Writing is a holistic communication process that requires the writer to generate meaning through composed text (Flower & Hayes, 1981). Literacy allows AAC users to communicate, engage in critical thinking and attain social and cultural power (Bishop, Rankin & Mirenda, 1994). It is very often used by AAC users with severe communication impairments to participate in successful face-to-face interactions by (Koppenhaver, Coleman, Kalman, & Yoder, 1991).

However, nearly 50% of the children who are included in regular education classes and with IQs in the average range demonstrate reading skills significantly below grade-level expectations (Berninger & Gans, 1986; Koppenhaver & Yoder, 1993). In an assessment of reading skills of individuals with severe cerebral palsy, Berninger and Gans (1986) reported that these individual's reading scores were disproportionately low compared with their measured IQ scores and discourse-level receptive language abilities. Many students with disabilities get 'stuck' at the emergent literacy level. This means that they may listen to text for enjoyment, gain information from listening, and participate actively in reading activities, but they are not able to independently read new text that is presented to them. This clearly limits students' ability to be competitive in school and to gain information independently (Erikson, Musselwhite & Ziolkowski, 2002).

Gaining information from text also may be more difficult for children who use AAC because of underlying language differences. Transcripts from children using aided or unaided AAC (Grove, Dockerell, & Woll, 1996; van Balkom & Welle Donker-Gimbrere, 1996) reveal differences in language production from those seen in children who use speech, including unusual word order and a tendency to string nouns together. Van Balkom and Welle Donker-Gimbrere (1996) argued that children who use AAC might develop parallel forms of language representation, with receptive language reflecting the spoken language in the environment, and expressive language reflecting inherent restrictions in the child's AAC system (e.g., limited vocabulary and the need for a "telegraphic" communication style to reduce manual demands). These differences have been linked to literacy performance.

Iacono and Cupples (2001) found that measures of receptive vocabulary and the ability to judge grammatically correct sentences correlated highly with measures of word decoding and reading comprehension in two groups of adults with complex communication needs. The correlations did not vary by whether the adults used high- versus low- technology systems. Some used graphic symbols on the devices whereas some used text-to speech or the alphabet to produce their messages. The suggestion is that children with adequate receptive language skills are good candidates for reading instruction, even if their expressive abilities are severely limited.

Of all the cognitive processes thought to be related to reading ability, phonological awareness, particularly at the phoneme level (e.g., knowing that words can be segmented into component sounds, as in /p/, /I/, /g/ for "pig"), has received the most research attention. Children with strong phonological awareness demonstrate the ability to learn letter-sound correspondences readily and to apply these correspondences in reading single words (Catts & Kamhi, 1999; Wagner & Torgeson, 1987). Conversely, poor phonological awareness has been associated with reading difficulties in children (Catts & Kamhi, 1999; Stanovich & Siegel, 1994; Wagner & Torgeson, 1987) and adults (Morais, Crary, Alegria, & Bertelson, 1979). Snow, Burns and Griffin (1998) reported a mean correlation of 0.46 across studies that examined phonological awareness at school entry and subsequent reading difficulties. The phonological awareness in children and adolescents who use AAC has been shown to be severely limited compared to peers without disabilities (Dahlgren Sandberg, 2001; Dahlgren Sandberg & Hjelmquist, 1996; Vandervelden & Siegel, 1999) or peers with physical disabilities who did not use AAC (Vandervelden & Siegel, 1999).

Non-verbal children who are AAC users face all of the challenges learning to read faced by typically developing children and many additional special challenges. The extant literature is

limited, but suggests that children who have adequate receptive language and phonological awareness have the emergent reading skills comparable to their peers. Yet few of these children do learn to read. A review of the existing research can provide insights into this problem.

Reasons for Limited Reading Abilities of Users of AAC Devices

Researchers have identified numerous reasons for the lack of literacy development in individuals who use AAC. Strum, Spadorica, Cunnigham, Cali, Staples, Erikson, Yoder and Koppenhaver (2006) identified three important factors that might contribute to the development of poor literacy skills for students who use AAC: (a) a lack of understanding of core literacy activities in the continuum of literacy development and the purposes of these activities; (b) limited access to curricular materials that support teachers in addressing individual learning needs, including physical access to materials and tools; and (c) teacher attitudes and beliefs. Beukelman and Mirenda (2003) list the following factors that might influence the development of literacy in children with severe speech and physical limitations: (a) physical difficulties; (b) limited world knowledge and vocabulary; (c) language impairments; (d) perceptual difficulties (e.g., hearing and vision); (e) discrepancies between reading achievement, receptive language and IQ scores; (f) poor-self esteem; and (g) passive learning patterns. Iancono (2004) identified similar intrinsic factors but also extrinsic factors important for literacy development in individuals with severe speech and physical impairments. These include (a) limited early literacy experiences, (b) poor preparation for reading instruction (which include letter identification, phonological awareness and an understanding of how print can be used), (c) low IQ scores, (d) limited language skills and (e) lack of appropriate reading instruction.

The problems of non-verbal children with AAC devices learning to read are multiple and complex. This study will focus on the following factors: (a) prerequisites for literacy

intervention, (b) low expectations of parents, caregivers and teachers, (c) limited access to literacy materials, and (d) lack of appropriate assessment tools.

Prerequisites (Communication Competence) for Literacy Intervention

As noted by Koppenhaver, Coleman, Kalman and Yoder, "Notions of prerequisites have made intensive exploration of literacy learning in children with developmental disabilities seem moot until recently" (1991, p.38). Little or no intervention for literacy was provided to students using AAC systems due to the presumed prerequisite skills needed for literacy. Traditional thinking was centered on the idea of a "reading readiness" stage, before "real" literacy learning can take place (Galda, Cullivan, & Strickland, 1993). This readiness skills approach artificially separated the areas of reading, writing, speaking and listening abilities and attempted to teach them in a "lock-step" fashion, starting with listening, followed by speaking, then reading and then finally to writing (Musselwhite & King-DeBaun, 1997). Goodman (1986) went further to list beliefs (that he rejected under the whole language approach) that supported the notion of reading readiness. These beliefs included: (a) isolating skills sequence, (b) slicing up reading and writing into grade level expectations; (c) looking at reading and writing as scores on tests measuring "sub-skills"; (d) isolating reading and writing from its use in learning or speaking and listening; (e) believing that there are substantial numbers of learners who may never learn how to read or write due to physical or intellectual reasons.

Goodman (1986) stated that language learning is hard when it is (a) artificially broken into broken into bits and pieces; (b) when it is nonsensical, dull and uninteresting; (c) irrelevant to the learner, belonging to someone else and imposed on the learner; (d) out of context with no social value or discernable purpose, and (e) inaccessible. He contended that these properties make the learner powerless, dependent and passive. Children who are nonverbal and forced to

rely on AAC devices for oral expression were regarded by their teachers and speech language therapists as not having the readiness skills for literacy until they mastered "speaking" with their communication systems (Beukelman & Mirenda, 2003). In many curricula, language learning for them is broken up into sub-skills that have no relation to learning language, leave alone literacy. They are required to work on (a) operational competence, (b) linguistic competence (c) social competence and (d) strategic competence (Beukelman & Mirenda, 2003). They are often taught these skills in isolation and therefore are rarely able to merge parts of skills taught into a complete ability. Intervention is limited to artificial "skill and drill" sessions where students practiced "learning" their communication devices through picture identification and locating symbols on their AAC devices.

The vocabulary programmed on the AAC devices belongs to parents, caregivers and teachers and is of little or no relevance to the child. Users of AAC devices rarely select their own lexicon for their communication displays but depend upon adults to do it for them (Beukelman, Jones & Rowan, 1989; Nelson, 1992). Non-literate individuals who are unable to spell well enough to formulate their messages and have limited reading skills have words selected for them by their caregivers (Beukelman & Mirenda, 2003). These generally aim to meet their daily living needs (e.g., toilet, eat and drink). Words are usually chosen from a functional perspective rather than a developmental perspective. The external lexicon or words on the communication device may not reflect an internal lexicon or words that reflect the thoughts of users of AAC devices (Smith, 1996; van Balkom & Welle Donker-Gimbere, 1996).

Vocabulary for literacy is seldom programmed on devices until mastery and competence is demonstrated in use of the communication device in functional daily living activities (which include words such "eat," "drink," and "toilet"). Researchers have suggested the combination of

core vocabulary (small vocabulary of words used across environments) together with fringe

vocabulary (words pertinent to a variety of activities) be used in combination to promote not

only functional communication across different settings, but also increase in language learning

through the use of appropriate syntax and novel utterances (Banajee, DiCarlo & Stricklin, 2003).

Core vocabulary words (such as prepositions, demonstratives and pronouns) are harder to depict

using pictures than fringe vocabulary words (e.g., nouns). Teaching how to combine core and

fringe vocabulary words assists in the development of syntax and in the use of simple sentences

during face to face as well as written communication. The child now has the opportunity to learn

syntax in the same way as a verbal child. The child has the same opportunities to make errors

and have the same opportunities to be corrected and receive feedback from his or her peers and

caregivers.

Another area of difficulty for users of AAC systems is the development of morphology

(O'Keefe & Dattilo, 1992, Sutton & Gallangher, 1993). Most clinicians feel that they have to

stress efficiency over accuracy as a strategy for enhancing the speech of communication (Light,

1989). Vocabularies programmed on communication devices usually take the form of full

sentences. Word based systems are considered difficult to master, take longer to access and

therefore rarely used by clinicians during intervention with children using communication

devices. Therefore vocabularies programmed on devices rarely contain morphological endings

for words (Blockberger & Johnston, 1997). Morphological endings are difficult to depict in

pictures, and their omission does not interfere with most messages. The teachers conclude they

are unimportant to place on communication devices. In addition, Picture Communication

Symbols (PCS) (that are used to depict vocabulary on communication devices) are often used to

depict a whole concept or sentence rather than a single concept or word. For example, the PCS

for "sit" is a girl in the process of sitting on a chair. Smith (1996) showed that when asked to point to "the girl is sitting on the chair," the user of an AAC device pointed to the single picture of sitting rather than "the," "girl," "is," "sitting," "on," "a," "chair."

Redmond & Johnson (2001) conducted a study on the use of morphological errors made by children with severe speech and physical impairments. In this study, grammaticality judgments were used to measure the sensitivity of 4 school-age children with severe speech and physical impairments to different morphological errors. Performance of these children was compared to groups of typically developing children and adults. Results indicated that both groups made similar judgments. All groups showed high levels of sensitivity to agreement violations, aspect-marking errors, and tense-marking errors involving irregular verbs, however; children with SSPI had greater difficulty detecting tense-marking errors involving regular verbs.

Vocabularies used on AAC devices rarely give their users an opportunity to experiment with sounds and develop phonological awareness. Research has demonstrated that phonological awareness can be taught and that improvement in phonological awareness correlates significantly with improvements in both reading and spelling achievement. This is true for both typically developing and "at-risk" students (Bradley & Bryant, 1985; Cunningham, 1995; Lundberg, 1988; Lundberg, Frost & Peterson, 1988; Mann, 1984; Wagner & Torgenson, 1987). Reading instruction for persons who use AAC must have a dual emphasis on automatic word identification and phonics or decoding skills. Skills in both areas enhance silent reading comprehension, as readers must be able to effortlessly recognize most words they encounter while simultaneously having the skills to figure out unfamiliar words (Erikson, 2000). Comprehension is adversely affected when instruction emphasizes only one skill. When readers are not taught skills to figure out unfamiliar words, they are forced to skip or guess words.

Likewise, when readers are taught to stop and sound out or consciously think about every word they encounter, they are expending cognitive resources that would otherwise be devoted to comprehension (Goodman, 1986). Unfortunately, users of AAC devices have opportunities to do both unless their devices are appropriately programmed with a sound/symbol overlay and they are helped to understand their form and function (Musselwhite & King-DeBaun, 1997).

A phonics page or a fringe vocabulary page pertinent to book reading can assist in learning how to read. With the use of a sound/symbol page the students are able to participate in phonics activities during reading and writing activities. Foley (1993) suggests the early introduction of communication devices that support development of phonemic awareness. Use of sound/letter overlays are recommended for use during writing tasks (Gerbers, 1995; Tractenberg, 1990; Yopp, 1995). Although several commercially available communication devices (e.g., the DV-4 or MT-4 from Dynavox Systems, and the Vanguard, Vantage and Springboard from Prentke Romich Company, Inc.) and software programs (e.g., Unity and Word Power from Prentke Romich Company, Inc.) have such pages preprogrammed, clinicians and teachers are not aware of their location and rarely use them for reading and spelling instruction (Musselwhite & King-DeBaun, 1997).

Koppenhaver, Coleman, Kalman and Yoder (1991) emphasized the need for functional use of literacy skills or using literacy to achieve a goal (e.g., to get something, to establish joint attention, comment on something, or to convey information). Teale and Sulzby (1986) make similar observations in that literacy develops in real-life situations, for real-life activities and in order to get "something done." Literacy training on AAC devices usually takes place in isolation in a clinical setting, out of context, where there is little opportunity for social interaction or purpose for using the systems. Devices are rarely available to the user during opportunities for

incidental reading and literacy. Communication devices are presented to the child at the convenience of the communication partner making language learning for literacy inaccessible for the child. AAC users are unable to comment while reading labels of foods in a grocery store or billboards during a car ride. They are also unable to initiate interaction or participate in discourse about a book that they read in school, or to talk about literacy experiences. Children who depend upon these systems become passive, dependent learners with little ability to communicate their needs and wants, or comment appropriately and in a timely manner. Since children using communication devices rarely reach competence levels with their communication devices, little or no opportunity is provided for the children to use their communication devices to participate in reading books or writing activities while using their communication systems. AAC users are often presented with opportunities to use their devices/symbols, but are rarely given opportunities to participate in reading and writing activities (King-DeBaun, 1993).

A reciprocal relationship exists between learning language and literacy (Koppenhaver, et al., 1991, Teagle & Sulzby, 1986). Literacy involves both oral and written aspects of language. It involves listening, speaking, reading, and writing abilities (Sulzby & Teale, 1986). When reading, writing and verbal expression come together, language is rich. A whole language philosophy presumes that reading, writing, and expression are integrated, not separate, entities of language (Goodman, 1986).

A whole aided-language approach is proposed by Musselwhite and King-DeBaun (1997). They purport that (a) reading, writing and verbal expression operate together to form language; (b) the child is viewed as a whole and teacher, therapists and parents should work collaboratively together; (c) non-speaking children should be exposed to all aspects of language at an early age; (d) language be used in the natural environment in activities that are authentic and meaningful;

(e) "communication time" is all the time and can be provided with aided language stimulation activities throughout the day and in all activities; (f) vocabulary for language and literacy need to be programmed in their systems; (g) concepts and ideas about print are introduced naturally throughout the day; (h) phonetics or letter-sound associations are embedded naturally and meaningfully into teaching techniques; and (i) parents and family are expected and encouraged to participate in the early language experiences.

Low Expectations of Parents, Caregivers and Teachers

Early experiences with print-based materials and involvement in reading activities have been argued to have a direct impact on later reading achievement. According to Catts and Kamhi (1999), the role of early joint-book reading has received the most direct investigation. Research synthesis, in the form of meta-analyses, by Bus, van Ijzendoorn, and Pellegrini (1995) and Scarborough and Dobrich (1994) indicated that preschool engagement in regular joint-reading activities with a parent accounts for approximately 8% of variance in subsequent reading outcome measures.

Koppenhaver, Coleman, Kalman and Yoder (1991) have noted concern that labels (e.g., "disabled," "delayed") may cause caregivers and parents to underestimate the abilities of children with special needs which in turn leads to reduced expectations for academics and literacy. In their survey research, Light, Binger and Kelford-Smith (1990) found that parents of children with severe speech and physical impairments rated literacy as a low priority, and care of physical and medical needs as a high priority. When literacy expectations of parents of preschool children with and without disabilities were compared (Light & Kelford-Smith, 1993), literacy achievement was rated considerable higher by parents of children without disabilities.

Parents of children with speech and physical impairments typically gave priority to face-to-face communication and development of independence in physical self-help skills.

Marvin and Mirenda (1993) compared home and school literacy expectations of 291 preschool children who were divided into three groups: (a) Head Start high risk students, (b) Special Education students, and (c) peer models. Although parents of children in Special Education identified literacy as being a desired skill for their children, they rated it as a low priority as compared to parents' ratings for the other two groups of children. They also had the lowest expectations for literacy for their children. Koppenhaver, Evans and Yoder (1991) surveyed 21 literate adults with severe speech and physical impairments. Mothers were cited 86% of the time as playing a central role in their literacy accomplishments. Parental support and high expectations were listed by 12 out of the 21 respondents as key factors in their literacy success.

Supportive homes were reported to be important but not sufficient to reverse the negative effect of a low-support school environment. A study of children without disabilities from low-income families in the United States suggests that consistent high-quality instruction in school can compensate for a home that provides low levels of support for literacy teaching. It is reported that two years of instruction in a highly supportive classroom allowed all of the children from low-support homes to achieve literacy learning success (Erikson, Koppenhaver & Yoder, 2002). Teacher expectations affect the way they behave, and the way they behave affects how students respond (Good & Brophy 2000). When teachers view students as capable of learning, they are more likely to engage students interactively, presenting them with active learning opportunities, searching for additional supports when learning does not proceed as expected

(Erikson, Koppenhaver & Yoder, 2002). It is critical therefore for teachers to reshape their classroom practices and present information in an active and engaging manner.

Limited Access to Literacy Materials

The Literacy Bill of Rights (Erikson, Koppenhaver, & Yoder, 2002) stresses the fact that individuals with disabilities have the right to have "accessible, clear, meaningful, culturally and linguistically appropriate texts at all time." These could range from picture books to newspapers to novels, cereal boxes as well as all electronic documents. Tools for developing literacy and encouraging creativity should be made accessible to all students (King-Debaun & Musselwhite, 1997).

The premise of constructivism based on the works of Vygotsky (1978) and Maehr (1991), emphasize the need for active participation of children in order to learn. To develop literacy skills, children must actively participate in the reading process. They need to play with books, hold them, turn pages, and be able to follow along as the adult reads. They also need to discover that books need to be held right side up, there is a difference between text and pictures, and that text goes from left to right. According to Maehr (1991) only children themselves can make sense of experiences they are actively engaged in; however, it is the important role of parents and teachers to create an environment to make this possible.

Recent research shows that children with special needs (Marvin & Mirenda, 1993) and preschoolers who use AAC systems (Light, Binger & Kelford-Smith, 1994; Light & Kelford-Smith, 1993) do not participate as actively in home story reading sessions as do typical children of the same age. Pierce and McWilliams (1993) provided a summary of factors that influence the nature and quality of active participations in literacy interactions.

Mike (1995) conducted an ethnographic study of the characteristics of participation in literacy tasks for 5 children with cerebral palsy between the ages of 10 and 14 years. All children were taught in a self-contained classroom. Classroom activities were observed over a 17 week period for 2 hours at a time, for a total of 120 hours. Results indicated that students were actively engaged in the process of reading only 15 minutes per day. In another study conducted by Koppenhaver and Yoder (1993), 3 boys between the ages of 10 and 14 years with severe speech and physical impairments were observed and videotaped while they participated in instruction with their teachers. Results indicated that only 2% of the instructional time was spent on literacy interaction. Of the time spent on literacy instruction, students engaged in transitional activities 34% to 38% of the time, in passive listening activities 23% to 29% of the time, and in active reading activities only 15% to 20% of the time. Most of the literacy instruction focused on reading, writing words and sentences in isolation, completing fill-in-the-blank exercises, and performing spelling drills.

Wasson and Keeler (1992) (cited in Koppenhaver & Yoder, 1993) observed the daily instruction provided to a set of 6 year old twin girls. One twin had severe disabilities and was placed in a special education classroom whereas the other who was typically developing was placed in a general education classroom. Both children demonstrated normal IQ scores and had similar home experiences. Shortly after starting first grade the twin with disabilities starting lagging behind her twin sister in literacy learning. The observations revealed that the twin with disabilities received 30 minutes of active participation in literacy activities for every 60 minutes received by her sister. In addition, no opportunities were provided for the twin with disabilities to comment on the book or to ask questions about the book. In a follow-up study of the same set of twins, where educational adaptations (e.g., cutting up workbook activities and placing them in

quadrants to facilitate selection via eye gaze) were made to encourage active participation in the literacy process, the researchers noted that an increase in active instructional time resulted in tripling of the student's responses during classroom literacy activities.

Reading aloud has been shown to be beneficial to reading development. Cullinan (1992) states that, "Reading aloud can be a true joy to both the reader and the person listening to the story." It is never too early or too late to engage in this activity. The desire to engage in later independent story reading can be motivated by reading aloud activities. Cutting and Milligan (1991) suggests that reading aloud familiarizes children to book language and story structure. Durkin (1996) observed 5000 children as they entered school. She observed that 49 children had reading skills at the 1.5 grade level. Three characteristics were present in the homes of these children: (a) somebody read aloud to them; (b) someone answered their questions, and (c) students enjoyed writing or making marks on paper. Staonovich (1991) reported that listening comprehension is the best measure of potential for reading comprehension for elementary school students without disabilities.

Studies suggest that children with physical disabilities have fewer quantitative and qualitative book reading experiences than their peers (Koppenhaver & Yoder, 1992). Several factors contribute to this discrepancy. Positioning is repeatedly mentioned as an obstacle by parents during storybook reading episodes. Parents feel that trying to read (while supporting a child with motor challenges, and holding the book so that both the parent and child can see) can be a juggling nightmare (Musselwhite & King-DeBaun, 1997). Reading experience for these parents is seldom reported as being pleasant. The child is rarely able to snuggle up or conform to the body posture of the parent, making the process impersonal and rarely resulting in bonding between the child and the parent.

Beukelman and Mirenda (2003) recommend the need for people with primary motor impairments "to be able to hold the text, turn its pages and otherwise access printed materials" for the purpose of developing reading skills and to learn academic content. Reading stands, book holders, ring splints that provide hand support for page turning and other low and high technology systems (e.g., talking switches, loop tapes and electronic page turners) are suggestions to help with active participation in the literacy process. A variety of computer access methods are also available to provide access to electronic and digital books. These include tract balls, track pads, expanded keyboards, head mice and pointing devices with onscreen keyboards, voice recognition systems, and single switch interfaces.

Practice is one component of immersion, or surrounding children with print and opportunities to use print (Cambourne, 1988; Eisle, 1991). When children are allowed to choose books to read with their partners they usually select the same ones over and over again. Repeated storybook reading is one of the essential features that contribute to the literacy process (Strickland & Taylor, 1989). A number of researchers have observed that children use repeated readings to make them more efficient in storybook interactions (Cazden, 1983; Samuels, 1985; Snow and Ninio, 1986; Teale, 1982). When stories are presented over and over again, adults gradually let go of their dominant role and allow children to take on more responsibilities for asking questions, predicting outcomes and inferring meaning. However, in many classrooms and homes this opportunity may be limited. Goodman (1986) reports that reading occurs only 6% of the class time in elementary schools and trails off to 3% in middle and to 2% in high schools. A number of studies have suggested even lower figures for children with special needs (Erikson, Koppenhaver, & Yoder, 2003; Erikson & Musselwhite, & Ziolkowski 2002; Koppenhaver, Evans & Yoder, 1991; Koppenhaver, Pierce, Steelman & Yoder, 1995).

In a survey conducted by Light and Kelford-Smith (1993), it was found that preschool children who use AAC systems to communicate had fewer opportunities for repeated reading than their peers without disabilities. They theorized that children without disabilities typically selected their own books for storybook reading, while mothers generally initiated storybook sessions with their children using AAC systems. Parents therefore were in control of the situation and usually selected the storybook. When children chose books, they usually pick books than are familiar (since they know the story and can predict events and outcomes); however, when the choice is left to the adult, they tend to choose new books as they tend to grow tired of rereading old stories.

Another factor that might influence providing repeated storybook reading opportunities is that the quality of experience of repeated storybook reading is not the same with children who use AAC systems. Light, Binger and Kelford-Smith (1994) compared the story book reading experiences of five preschoolers who use AAC systems and their mothers, looking at both familiar and unfamiliar books. They found that children who used AAC systems (as compared to their peers) were unable to assume a more active role during storybook reading with their parents. It was noted that children who use AAC systems rarely had access to their communication systems while reading stories and were therefore unable to interact appropriately with their parents while reading books. Due to physical limitations they were also unable to point to pictures and text and engage in joint attention activities as reported by their more able bodied peers. Limited access to the active process of reading and the lack of ability to interact with the person reading the storybook may result in providing fewer opportunities to these children for repeated readings of storybooks.

In addition, parents took on a more dominant role while reading to their children with severe speech and physical limitations. They provided children who use AAC systems limited opportunities to interact with the storybook as well as to engage in interaction with them while reading the storybook. They failed to read the child's nonverbal cues and therefore limited their active learning experience (Musselwhite & King-Debaun, 1997). It has been suggested by these authors that caregivers and parents should make time to read to their children. Fielding, Wilson and Anderson (1986) showed the powerful impact on literacy achievement of just 10 minutes of reading aloud per day. The authors asked students and caregivers to keep a log of the amount of time they read at home. Children who read at least 10 minutes per day were found to have higher reading achievement scores.

During reading, it is important to support the child's head and assist with pointing. Book stands and other adaptations (e.g., supported seating options) may help to make words and pictures visible to the child as the book is read (Musselwhite & King-DeBaun, 1997). The child should be offered a choice of books before starting the book reading process. The child should be observed for cues regarding his favorite books and the same books should be offered even though it might be repeated several times. Use of eye gaze and vocalizations should be recognized to interpret choices. Repetition and practice is essential to developing literacy skills.

It is important to encourage participation of the children during story book reading. They need to be encouraged to point to the pictures and text on the page. Supporting the child's elbow and shoulder should free up the hand in order to touch the page. Use book adaptations such as "page fluffers" (pieces of Velcro, magnets or other materials that can help to separate pages of a book) to encourage children to independently turn pages of a books using a magnetic wand or gross physical movements. Read the nonverbal responses of the child. These might include

cooing, laughing, smiling or getting upset. Honoring the choices made by the child, even though they may not be the ones that you would have made and giving them consequences of those choices is important. Children quickly lose interest in an environment they can never hope to control (Korsten, Dunn, Foss & Franke 2006).

Similar needs were stressed by Strum, Spadorcia, Cunningham, Cali, Staples, Erickson, Yoder, and Koppenhaver (2006) for school-aged children attending school in first and third grade and who use AAC systems. They identified two important factors that might influence literacy development in young school aged children: (a) knowing which activity is most likely to result in literacy learning, and (b) understanding how to adapt the tasks to enable active participation. Activities included in the core reading curriculum that might have implications for AAC users were identified as automatic word recognition, decoding, text comprehension, and independent reading. To be able to develop and demonstrate automatic word recognition, and participate effectively in the shared reading, the student who uses AAC needs access to tools for communication and participation. Picture, word, or spoken messages available on AAC systems could include key vocabulary from the book and vocabulary choices to share feelings and comments (e.g., funny, silly, sad, surprised).

Difficulty with Assessing Students Reading Level

Phonemic awareness is the awareness of sounds in spoken words. Phonics is the relationship between letters and sounds (Stahl, 1992). Research (Juel, 1988; Lundburg, 1988; Wagner & Torgensen, 1987) suggests that phonemic awareness is an important precursor to success in reading. Stahl (1992) indicates that the absence of phonemic awareness leads to reading difficulties.

Several authors (Blischak, 1994; Foley 1993; Foley & Staples, 2003) have suggested that students with severe communication and physical impairments need specialized assessment to evaluate their phonological awareness. As Foley (1993) notes, most traditional methods used to assess phonological awareness may not be appropriate for children who have severe communication and physical impairments. For example, a child with severe speech impairments may not be able to say the sounds or words as required by phonological awareness tests. They are also unable to verbally produce words that rhyme or blend sounds together and verbally produce the resulting word. Speech language pathologists and teachers have to develop creative ways of assessing phonological awareness skills of these children using nonverbal means (e.g., choice making or eye gaze using correct sound productions and foils on a choice board).

Erikson (2000) reported on other test measures used to determine literacy skills including the Clay's literacy assessment program that assesses students' ability to understand text. The skills assessed include: (a) book orientation, (b) print carries meaning, (c) directionality, including top to bottom and left to right, (d) relationship of oral language to print, and (e) print conventions. A child with severe speech and physical impairments is unable to hold or manipulate the book and is therefore unable to show correct book orientation. Severe physical impairments cause the child to be unable to demonstrate directionality. Physical impairments prevent the child to be able to turn pages of a book to demonstrate left to right book direction. In addition, since they are unable to use their finger to trace left to right direction of text, it cannot be determined conclusively whether the child with severe physical impairments is able to understand that while reading the text goes from left to right. Similar difficulty occurs during silent reading where the child is required to track text from left to right without physical

guidance. This, confounded with the inability to verbally read the text aloud, makes it very

difficult to determine the child's reading ability.

It is also difficult to determine whether children with severe speech and physical

impairments understand text or make associations between language and text after silent reading.

Severe speech and physical impairments prevent them from answering questions about the text

in the conventional oral manner. Iacono and Cupples (2004) developed an internet based

assessment to determine phonological awareness and reading skills of adults with severe speech

and physical difficulties. The World Wide Web project undertaken by them required (a) the

development of a protocol for assessing reading and phonological awareness skills of users with

severe communication impairments, (b) assess reading skills of individuals with physical and/or

cognitive impairments, (c) provide participants with access to the World Wide Web, (d) develop

and test a world wide web intervention for reading. Focus teams were used to determine the

usefulness of such assessment procedures. The focus teams felt that the passages used were

boring and of little interest value. They felt they had little choice of choosing the text they

wanted to read. Also, the assessment was geared towards adults (used pictures that were adult

oriented) and required at least a 4th grade reading level to be able to access the internet. Ability

to access the computer and the internet were also prerequisites to administration of this

assessment. Thus, the assessment has limited application for younger children and those that

who are unable to access the computer or the internet. It required use of high technology tools

and internet access which may not always be available during assessments.

The same is true about demonstrating understanding of print conventions. Children with

severe speech and physical impairments are unable to verbally name letters or produce the sound

made by individual letters. Similarly these children are unable to verbally sound out words and

orally identify them. They are also unable to demonstrate how to segment words into syllables.

Physical impairments prevent them from clapping or tapping out the number of syllables in words.

Several suggestions have been made by researchers to resolve these issues surrounding testing. Erikson, Musselwhite, & Zialkowski (2006), Koppenhaver (2000), and Foley & Pollatsek (1999) suggest using multiple choice or a yes/no answer format whereas Vandervelden and Siegel (2001) suggest use of correct responses and foils to be placed on a choice board (a piece of cardboard covered with Velcro sensitive material). Eye gaze, head pointer, head light or gross hand movements can be used to identify correct responses. King-DeBaun and Musselwhite (1997) suggested using different adaptations to make assessment protocols more accessible to students with severe physical disabilities. These include: (a) copying test pictures and separating them on an eye gaze frame or choice board (a piece of cardboard covered with Velcro sensitive material), (b) using a yes/no response, (c) using correct answers and foils on an eye gaze frame or a choice board and (d) copying and placing test pictures on a circular scanner (e.g., the Dial Scan).

Bristow and Fristoe (1988) adapted two different tests (Preschool Language Scale and the Peabody Picture Vocabulary Test). Pictures from the two tests were photocopied and separated. A head-pointer and eye gaze was used to indicate their response. The researchers administered the adapted and regular form of the test to typically developing children. No difference was reported on the scores achieved on the adapted and regular forms of the test.

Iacono and Cupples (2004) developed and administered a series of phonemic awareness and single-word reading tasks to people with 40 adults with complex communication needs. One of the aims of the study was to determine the construct validity of the phonemic awareness tasks

that required a nonverbal response. Data from all participants, including those who used speech, were included in a factor analysis. Analysis indicated that the phonemic awareness tasks could be loaded onto a single factor which was concluded to be phonemic awareness. These results indicate that the tasks developed provide a valid means of assessing phonemic awareness and single-word reading skills. In addition, the results indicate that adults with complex communication needs demonstrate the same positive relationship between phonemic awareness and reading as has been found in other groups of individuals with or without disability.

Alternative methods for assessing children with severe speech and physical impairments have been demonstrated to result in reliable measures of abilities such as phonological awareness and early reading skills. Identifying what skills children are lacking is a first step toward providing appropriate literacy instruction. Finding instructional methods that work effectively with this population is the critical next step toward higher literacy for AAC users.

Phonology, Phonemic Awareness, and Phonics

While the logistical problems for AAC users present many challenges for literacy, mastering early reading behaviors such as alphabet knowledge and phonological awareness also present challenges. Dalhgren and Sandberg (2001) suggested that lack of productive speech contributes to the difficulties experienced by AAC users as they attempt to develop early reading skills. They proffered that lack of speech prevented children from manipulating the sound structure of language, resulting in a less stable representation of sound structure in their working memory. This poor representation of sound could be a contributing cause for a delay or even the inability to read and spell. They suggested use of visual and auditory input strategies to assist these children in develop adequate literacy skills.

Features of Language

The sound system of each language can be described by its phonemes and phonological distribution or patterns (i.e., phonology). Each child must learn which allophones are categorized as the same phoneme in a language versus those that represent a meaningful difference. Some differences between phonemes are larger whereas some are subtle. For example, the velar sounds /k/ and /g/ differ only in terms of the use of voicing, whereas /k/ and /ʃ/ phoneme differ not only in terms of the manner of their production but also where they are produced. The phoneme /k/ is a plosive sound that is produced at the back of the oral cavity whereas /ʃ/ is a fricative produced by the elevation of the tongue blade to approximate the hard palate. Allophones are variant forms of phonemes (e.g., the phoneme /p/ is different in spin and pin). Those features that make them different are called distinctive features. The brain and the ear work together to make sense of what we hear using distinctive features of language and contexts. In addition phonemes change with sounds that precede and follow it. They change when they are unstressed (e.g., con′test/con test′). They disappear in certain sequences (e.g., wanted or counted) and vary in length (e.g., /t/ in stick) in others (Goodman, 1993).

The alphabet is a way of visually representing the oral sounds of the language. Most modern Western European languages use the Roman alphabet with modifications to it. To make the task of the writer easier, alphabetic writing systems use a limited number of letters composed of a small set of repetitious strokes (Goodman, 1993). As writing become more efficient (with the use of fewer strokes) it also became more ambiguous (e.g., 1, I, l). Just as phonemes have variations (allophones), so do letters of the alphabet. These variations are called allographs. An example of this would be a typewritten capital letter H vs. a printed lowercase letter h vs. a cursive letter h.

Phonics is the process of relating orthographic patterns to phonological patterns. This is not an easy task since in English letters do not represent sounds in a one-to-one correspondence. Twenty-six alphabet symbols are required to represent forty-four phonemes of the English language. Some letters therefore make more than one sound (e.g., c is used to represent /s/ and /k/) and a combination of letters represent other sounds (e.g., sh is used to represent /ʃ/). These letters or groups of letters that represent a phoneme are called graphemes. American Heritage® Dictionary of the English Language (2000) defines graphemes as letters and letter combinations that represent a phoneme (e.g., *f, ph,* and *gh* are graphemes for the phoneme /f/).

Phonological Awareness

Phonological awareness is the ability to think about, reflect on and manipulate the sound structures of a language (Gough, Bradley & Bryant, 1983, 1985; Gough, Larson & Yopp, 2000; Yopp, 1988). Phonological awareness has been found to be the single best predictor for the development of future reading difficulties in young children, although higher level language skills were not examined in these studies (Blachman, 1983; Bradley & Bryant, 1983; Cunningham, 1995; Perfetti, Beck, Bell, & Hughes, 1987).

Many tasks have been designed to examine phonological awareness, including rhyming words (Goswami & Bryant, 1990; Stanovich et al., 1984; Yopp, 1988), identifying the initial sound of words (Stanovich et al., 1984; Yopp, 1988), parsing a sentence into words and words into syllables (Sawyer, 1987), and counting or indicating the number of sounds in a word (Sawyer, 1987; Yopp, 1988). The research was synthesized by Robertson and Salter (1997) to assess a comprehensive range of phonological awareness skills (i.e., rhyming discrimination and production, segmentation into sentences, syllables, and phonemes, isolation of sounds in the

initial, medial and final positions, deletion, substitution, and blending, as well as alphabet and phonic skills (knowledge of graphemes and decoding). Rhyming discrimination is the process of identification of rhyming words when presented in pairs whereas rhyming production is the task of providing a rhyming word when a stimulus word. Segmentation is the task of dividing sentences into words, words into syllables and syllables into individual phonemes. The task of identifying initial, medial and final phonemes is called phoneme isolation. The ability to say a word and then say it again by deleting a root word, syllable or sound is known as deletion. Substitution involves the ability to mentally delete one sound from a word and then substitute it with a sound to form a different word. Blending involves the use of combining sounds or syllables to form words.

The nature of the relationship between phonological awareness and print awareness remains unresolved. While some researchers believe the relationship between phonological awareness and reading is causal, and that phonological awareness is a necessary prerequisite to reading (Bradley & Bryant, 1983, 1985; Gough, Larson, & Yopp, 2000; Juel, 1988), others believe the relationship is more reciprocal (Norris, 1998; van Kleeck, 1998; Weaver, 1994). The National Reading Panel Report (Ehri, Nunes, Willows, Schuster & Shanahan, 2001) concluded from a review of 52 studies that training in phonemic awareness helps to improve reading and spelling for typically developing, at-risk, and struggling readers. They also reported that research demonstrated phonemic awareness instruction was most effective when taught in conjunction with letters.

Phonemic Awareness and Iconic Alphabet

Sound blending using alphabetic letters requires a high level of phonological awareness and symbolic organization. Figure 1a depicts the cognitive structure required for phonological

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awareness tasks and decoding. To perform these tasks, a relationship must exist between the concept of a cat (the signified) linked to the symbol or word signifying the concept. The word is hierarchically and reciprocally linked to the mental concept of a sound and sound patterns that are simultaneously recognized as segmented phonemes and phonemes within a phonological pattern (i.e., phonological awareness). These in turn are linked to alphabetical symbols, or letters, signifying the mental concept of a phoneme. With this hierarchical structure, transformations can occur such as deleting sounds (/k/ /at/), rhyme (/m/ /at/), adding sounds (/s/ /cat/), or substituting sounds (/k/ /o/ /t/). Letters can be associated with words ("c" is for cat), and the first sound segmented away from the symbolic word to result in /k/ ("c" makes the /k/ sound).

A very different conceptual structure is depicted in Figure 1b. In this case the relationship of the letter to the sound is memorized and the conceptual structure is indexical, with the letter associated with the sound only because they occur together during direct instruction. A visual concept (the letter "d") is associated with a sound (/d/) in much the same manner that a dog is associated with the sound "woof." The relationship is not hierarchical and symbolic, but rather conceptual and indexical. The 3 letters are isolated with no conceptual structure linking them to each other or to a symbolic word or mental concept. Thus, even when the 3 sounds are pronounced in sequence a word cannot be heard, nor can transformations be performed. No matter how quickly the sounds are uttered, they remain 3 separate sounds rather than components of a word. Children with severe speech and physical impairments are at-risk for developing the second type of conceptual structure for letters when they are learned since they may lack the literacy experiences that build a hierarchical structure.

| Hierarchical Structure (symbolic) | Conceptual Structure (indexical) | Iconic Bootstrap to Hierarchical Structure (iconic and symbolic) |
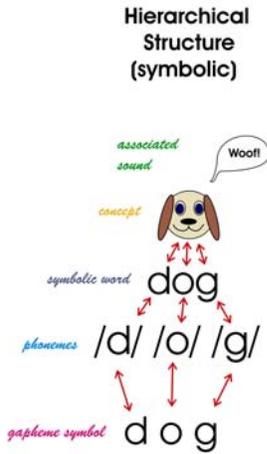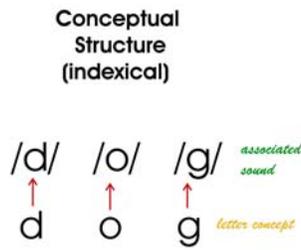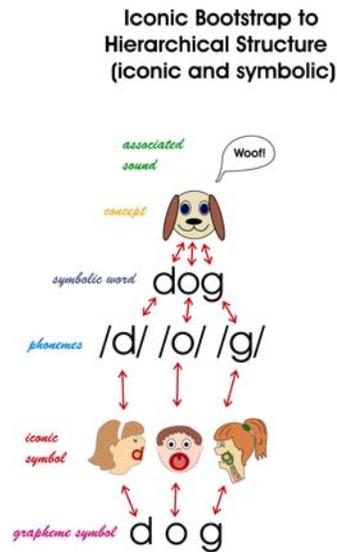
Figure 1a   Figure 1b   Figure 1c

Figure used by permission of Norris (2001).

An alternative model for acquiring the desirable hierarchical structure is profiled in

Figure 1c. In this model, an alphabet termed Phonic Faces (Norris, 2001) is designed to

iconically show the relationship between letters and sounds. In Phonic Faces, a letter is drawn in

the mouth of a character to represent relevant features of speech production. For example, the

curve of the letter "d" is drawn as the oral cavity and the vertical line is drawn as the elevated

tongue tip. In addition, a drumstick is embedded over the tongue, cuing the child that a short

drumming (i.e., stop plosive) motion is produced by the tongue. Phonic Faces therefore help to

connect visual features of a letter with the acoustic characteristics of the sound as well as the

kinesthetic positioning of the oral-motor mechanism (e.g., tongue and lips) while producing the

sound. As an iconic representation, the letter in the face teaches the child relevant information

about the letter and its sound. This representation does not require that the child already have

phonemic awareness as typical picture cues demand. For example, the association "d" is for

"dog" requires the child to segment the symbolic word "dog" into phonemes, delete all but the

initial phoneme, and then associate that phoneme with an arbitrary letter.

Figure 2
Figure used with
permission Norris
(2001)

Doyle (2002) and Nettleson and Hoffman (2006) used Phonic Faces storybooks to teach articulation to preschool children with delays. Measures of phonology and phonological awareness were obtained pre and post intervention. In both studies, phonological awareness increased. Preliminary analysis of a current study (Brazier-Car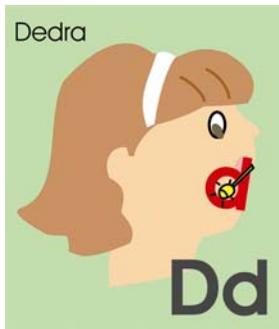ter, in progress) indicated that children made greater gains in phonological awareness and print awareness following 6 weeks of book reading in the Head Start classroom using the Phonic Faces books compared to traditional emergent reader storybooks. Each Phonic Face Storybook focuses on a particular phoneme and the corresponding letter (e.g., *Dedra Drums* focuses on the letter "d" and the corresponding sound /d/). The letter "d" occurs in words throughout the book in all three positions (initial, medial and final) and in the capital and lower case format. The letter is also associated with its corresponding sound /d/ as Dedra drums throughout the story with letter "d"s shown as notes that emit from her drum. Children are encouraged to make the /d/ sound to correspond with the patterns of notes, including the final page where she breaks her drum and instead uses her mouth. Thus phonemic awareness can be taught in a functional activity of reading a storybook. Children with severe speech and physical impairments are at risk for developing phonological awareness, in part because they are unable to actually produce the sounds due to oral motor difficulties (Beukelman & Mirenda, 2003; Strum, Spadorica, Cunnigham, Cali, Staples, Erikson, Yoder & Koppenhaver, 2006). Phonic Faces provide visual images of how the articulators need to be placed in order to produce different sounds. At the same time, Phonic Faces link the sound to its letter counterpart. These cues may provide children with severe speech and physical impairments with a means to understand the connection between the sound and the manner in

which it is formed to its corresponding letter. Children with severe speech and physical impairments could potentially link letters to sounds and sounds to letters, while at the same time developing prerequisite skills for manipulating sounds and letters while using rhyme, word recognition, sound and letters in different position in words and spelling.

Another difficulty that places children with severe speech and physical impairment at-risk is the lack of independent accessibility to reading materials. E-books (electronic books) can be used to provide greater independent access to reading materials (Burkhart, 1993; Erikson, Musselwhite, & Zialkowski 2002; King-DeBaun & Musselwhite, 1997). The Chaffe commission allows the adaptation of books and production of e-books for the use of persons with disabilities. Under this ruling, paper books can be adapted (converted into e-books) for specific use with people with disabilities without permission from the author provided a paper book is purchased before adapting or converting the book into an e-book. Books in full color can be scanned into a common software program such as Microsoft Office Powerpoint (Microsoft Office, 2003). This enables the child to turn pages (or slides) of the e-book using a mouse click. The mouse click can be accessed with a switch using the Switch Interface (Don Johston Co., Inc.).

Typically developing children begin to point to text and read highly familiar books verbatim as they make discoveries about print conventions and concepts of wordness (Teale & Sulzby, 1986). To simulate these experiences, words and sentences (story lines) can be made to scroll across the top or the bottom of the page using a mouse clicks or switches access (via the Switch Interface). Speech or storylines can be recorded using a microphone providing auditory feedback as the words scroll across the page. Sound and letter association can be modeled by highlighting the letters while the auditory program produces the associated sounds. Animation

can be added to the pictures to attract attention to the relevant pictures and enable young children to follow the story. In addition, phonological awareness can be addressed while reading the storybook. Phonic Faces can be added (scanned) to the dynamic display communication devices of the children. Children with severe speech and physical impairments can be taught to match letters to sounds while reading the books and to respond "verbally" using their communication devices. The books simulate many of the book reading experiences from which typically developing children benefit.

The purpose of this study is to determine if the Phonic Faces alphabet embedded within meaningful reading experiences (i.e., Phonic Faces alphabet-storybooks) will improve the emergent and beginning reading skills of children with disabilities using an AAC device. To address this, the learning resulting from Phonic Faces stories were compared to that of a traditional alphabet book within and across sessions. The following questions were specifically addressed:

1. Will targeted letter-sound recognition show greater gains following the reading of a Phonic Faces alphabet storybook in an e-book format compared to reading a traditional alphabet book in e-book format?

2. Will letter in word position recognition improve for the targeted letter following the reading of a Phonic Faces alphabet storybook in e-book format compared to reading a traditional alphabet book in e-book format?

3. Will learning occur for phonological and print awareness skills that are visualized or talked about in the e-book but not targeted for learning?

METHODS

Three children with severe speech and physical impairments participated in the study, which was implemented at the children's homes. The duration of the study was 10 weeks. The first and last weeks were devoted to pre- and post-testing and 8 weeks (i.e., 1 hour 4 times weekly) were devoted to intervention. Sounds to be targeted during intervention were determined using The Phonological Awareness Test (Robertson & Salter, 1997) during pre-testing. During the intervention sessions, the children were presented with the target sounds using e-books. Target sounds were subjected to the Phonic Faces Storybooks and Alphabet Storybooks alternately in a random manner during each session.   Five probes were used to assess the change in the phonological skills of the children at the end of each session.

Subjects

Participants were 3 children between the ages of 5 and 9 years who were using AAC devices to augment or compensate for limited speech production. Subjects were selected on the basis of the following criteria: (a) all children were emergent readers (that is, they recognized some sight words but could not read connected text); (b) all children had age appropriate receptive language skills; as determined using the Nonspeech Test (Huer, 1995) administered before they were selected as appropriate candidates; (c) all children were able to use their communication devices without any difficulty; (d) all children had normal vision and hearing (as reported by their last vision and hearing examination).

All three students were subject to pre and post test procedures and test probes (during the intervention) that required oral responses. To compensate for severe speech and physical impairments of the students, several adaptations were made to the pre and post test procedures as well as the test probes. Detailed descriptions of the adaptations are included in the Appendix A.

Subject A (SA) is an 8:9 year old female. She was diagnosed with cerebral palsy due to birth trauma. She is non-ambulatory and is dependent on a wheelchair for her mobility. SA is in a self-contained classroom in a local public school system. Her communication device consists of a PC tablet which she accesses using direct selection (i.e., a sweeping hand movement and finger tips to touch pictures). Although her movements are slow given a rate per minute she is accurate in accessing her device. She has been using her present communication systems since January 2006. She uses Speaking Dynamically Pro (Mayer-Johnson Company, Inc, 2004) software that presents Picture Communication Symbols (i.e., colored line drawings which depict different abstract and concrete concepts from Mayer Johnson Company, Inc., 1990). She uses an eight location overlay (i.e., eight pictures separated with black grid lines). SA's communication skills were evaluated in July 2005 using the Nonspeech Test (Huer, 1995). Her receptive language skills were found to be at the 8:6 years level and her expressive language skills were at the 2:9 years. According to her comprehensive 3 year Pupil Appraisal evaluation conducted in August 2005, her cognitive skills were determined to be at the 8:8 level. No reading levels or scores for phonological awareness were available at the time of the study.

Subject B (SB) is a 6:1 year old female with a diagnosis of cerebral palsy due to birth trauma. She is dependent on a wheelchair for ambulation and is dependent on adults for all her personal needs. SB is included in a kindergarten classroom with typically developing peers. She uses a Spring Board (Prentke Romich Company, 1999) communication device with a dynamic screen display (i.e., category symbols on the main overlay are linked to other screens representing each category). She accesses the communication device using scanning (i.e., symbols are highlighted on the display in sequence and SB uses a rocking lever switch to stop the highlighting on the desired symbol. The switch is positioned near her head and she uses a

head tilt to press the switch. She uses an eight location overlay with Minspeak (Baker, 1983) symbols (i.e., colored, iconic pictures which demonstrate concrete and abstract concepts). SB's communication skills were assessed in June 2005 and her receptive language skills were determined to be at the 5:4 year level and her expressive language skills were at the 2:2 year level. Her cognitive skills (according to her comprehensive 3 year Pupil Appraisal evaluation) are estimated to be at the 2:2 year level. SB had not been tested for reading levels or phonological awareness.

Subject C (SC) is a 5:0 year old girl with a diagnosis of Downs Syndrome. Although she is verbal, her articulation skills render her speech unintelligible and her intent unclear. She communicates using short phrases and sentences of 2-3 word combinations. She uses manual signs, a mid-tech communication device (TechSpeak (AMDI, 1995) and speech to interact with her peers and adults. The TechSpeak is a static display communication device (i.e., uses a paper overlay with pictures which can be accessed using directly touching the pictures). She uses the device in 32 locations; however, not all locations are programmed or contain a picture. Pictures are placed on every other location and only the locations with pictures have messages programmed on them. She attends a local public school and is in a self-contained classroom with 5 other children. She accesses a communication device using her index finger (which she isolates inconsistently) or her thumb. Pictures used on the device consist of a combination of photographs (of the family members) and Picture Communication Symbols (Mayer Johnson Company, Inc., 1990) (i.e., colored line drawings). Sentences and phrases are programmed under each picture on her communication device. Although the 32 location overlay supports using words in combination, SC does not as yet independently pair two pictures together in a sequence. Her receptive language skills are at the 4:8 years level and expressive language skills

at the 2:8 years level. Her cognitive skills according to her 3 year comprehensive evaluation were determined at the 4:8 years level. Her therapists report that she recognizes the letters of the alphabet but does not name any sounds. Her reading levels or phonological awareness skills had not been formally evaluated.

Table 1
Profile of Participants, Including Age, Gender, Receptive and Expressive Language and Cognitive scores.

SA					SB					SC				
		Recp.	Expres.				Recp.	Expres.				Recp.	Expres.	
Age	Sex	Lang.	Lang.	Cog. Level	Age	Sex	Lang.	Lang.	Cog Level	Age	Sex	Lang.	Lang.	Cog. Level
8:9	F	8:6	2:9	8:8	6:1	F	5:9	2:2	6.0	5:0	F	4:8	2.8	4:8

No reading levels were available before starting the research study. Reading levels of all three students were pre-tested using the Informal Reading Inventory – 8th edition (Burns & Roe, 2006) The results of word recognition, listening comprehension and silent reading are profiled in Table 2. Reading levels of all three subjects were determined to be below the pre-primer level.

Table 2
Pretest Scores for Word Recognition, Silent Reading and Listening Comprehension Subtests of the Informal Reading Inventory for all three Students with Severe Speech and Physical Impairments

Dependent variable	Subject SA		Subject SB		Subject SC	
	% Correct	Reading Level	% Correct	Reading Level	% Correct	Reading Level
Word recognition	20	Below Pre-primer	30	Below Pre-primer	10	Below Pre-primer
Listening Comp.	32	Below Pre-primer	45	Below Pre-primer	28	Below Pre-primer
Silent reading	25	Below Pre-primer	37	Below Pre-primer	23	Below Pre-primer

Phonological skills were assessed during pre-testing on 7 subtests (rhyming, segmentation, isolation, deletion, substitution, blending and graphemes) of the Phonological Awareness Test (Robertson & Salter, 1997) for all three students. Results of the test are profiled in Table 3. Results were determined to be in general in the very poor to low average range (standard scores ranging from 58 and 90).

Table 3
Pretest Scores for 7 Subtests of the Phonological Awareness Test for Three Students with Severe Speech and Physical Impairments

Dependent Variable	Subject A	Subject B	Subject C
Rhyming			
Percentile rank	9	3	2
Standard scores	72	61	71
Segmentation			
Percentile rank	5	5	4
Standard scores	73	74	72
Isolation			
Percentile rank	9	7	21
Standard scores	71	74	83
Deletion			
Percentile rank	8	6	7
Standard scores	75	73	74
Substitution			
Percentile rank	9	8	28
Standard scores	83	76	90
Graphemes			
Percentile rank	7	3	20
Standard scores	69	58	81

Procedures

Three subjects were provided intervention for reading using a single subject across subject and alternating conditions (ABAB) design. Each subject was assessed for early reading behaviors using a reading inventory and phonological awareness test adapted for a nonverbal

response mode. Results of this battery were used to select 2 letters and their corresponding sounds, and the segmentation of those letters from words for targeting during the intervention. Subject SA worked on letters "k" and "s", subject SB worked on "r" and "t" and subject SC worked on "t" and "p".

Pretest/Posttest

Each participant was administered a battery of formal and informal test instruments to establish present level of knowledge and skills. The participants were tested at their home or in the clinic where they attend speech language therapy. The participants were assessed across the first week of the study (approximately two sessions).

A. The Informal Reading Inventory, 8th edition (Burns & Roe, 2006). This reading inventory presents graded word lists (i.e., 20 words presented in isolation) and reading passages with readability established at the preprimer through 12th grade levels. The first 4 passages are followed by 8 questions, while 10 questions are asked for the 1st grade passages and above. The inventory has 3 equivalent forms (i.e., A, B, and C). The inventory is not based on norms; rather the words, passages, and questions have been designated to be at the specified grade level and child performance is compared to that criterion. The method of responding is typically oral, so the tasks have been modified to accommodate the response needs of the participants. Accommodations made to the test items are listed in Appendix A. At posttest, Form C was administered using the Graded Word Lists and the Oral Reading Comprehension procedures. Gain scores between pretest and posttest were compared.

B. The Phonological Awareness Test (Robertson & Salter, 1997). This assessment battery evaluates phonological awareness, grapheme knowledge, and decoding skills using separate subtests. The following subtests were administered:

   a. Rhyming, Discrimination: This task measures the student's ability to identify rhyming words presented in pairs using a yes/no response.
   Rhyming, Production: This task assesses the student's ability to provide a rhyming word when given a stimulus word. It requires the subjects to orally give the correct rhyming word.

   b. Segmentation: The test requires the subjects to divide sentences into words, words into syllables and words into phonemes or sounds. An oral answer indicating number of segments is required.

   c. Isolation: The test requires subjects to identify a phoneme by positions in a word (initial, final and medial). An oral response indicating the location of the phoneme is required as a response.

   d. Substitution: This test requires the subjects to isolate a sound in a word, change it to another sound and form a new word. Oral naming of the new word is required as a response.

   e. Deletion (compounds and syllables): This task measures the subject's ability to say a word and then say it again, deleting one root word or syllable.
   Deletion (phonemes): In this test, the subject says a word and then says it again, deleting one of its phonemes or sounds. Both parts of this test require a verbal response of correct new word.

f.   Blending subtest: assesses the subject's ability to blend units of sound together to

form words. The student is required to orally say the word after blending the

sounds together.

g.   Graphemes subtest: assesses the subject's knowledge of sound/symbol

correspondence. Given the printed letters, the student says the sounds represented

by the letters.

Materials

Alphabet Stories (adapted): Alphabet Stories (Pemberton, 2004) are story pictionaries.

This book represents a "typical" alphabet book approach, where objects that begin with a letter

are depicted on a page. The Alphabet Stories differ from the typical alphabet book which

encompasses the entire alphabet, devoting 1-2 pages per letter. Instead, there is a separate

Alphabet Storybook for each letter. In each book, the characters go on a field trip to find the

things that begin with the target letter. Each of the 7 pictionary pages introduces an item that

begins with the target sound, names the item, associates the item with the letter name, and puts

the item in the pictionary. The printed word for each item and related alphabetical letter are in

bold face on the page. Although these books are not thought to be best practices while teaching

reading, they are an example for books typically used by speech language pathologist during

literacy training.

These on-line books for educators were copied into Microsoft PowerPoint format

(Microsoft Office, 2003) and expanded to include an introductory page and 11 pictionary pages

using clip art to generate the new illustrations. The books were downloaded into a file on the

computer and converted into e-books using Microsoft PowerPoint (Microsoft Office, 2003).

Each page of the book was copied and pasted on individual slides. Text corresponding to each

page was typed in and made to scroll across the page using a mouse-click. The examiner also recorded spoken text which programmed to play as the text scrolled across the screen. No animation was not added to the picture since the pictures included pictures of items (to be included in the pictionary) and did not support a story format.

Transitions between each page were also programmed so that each page could be "turned" using arrow keys and a mouse click. The mouse click was made accessible using a switch interface (hardware from Don Johnston Company) and rocking lever switch (e.g., Jelly bean switch from Ablenet, Inc.). Subjects were now able to press the switch (with their hands or a lateral movement of their head) in order to produce a mouse click function. Using this accommodation, all three students were able to independently turn the pages and read the books.

Phonic Faces Alphabet Storybooks (adapted): Phonic Faces Alphabet Storybooks (PFAS) are designed to incorporate features of both alphabet books and storybooks. Each book focuses on one phoneme and its corresponding letter (i.e., consonants), consonant or vowel digraph (i.e., "ch," "oi"), phoneme variation (i.e., voiced and voiceless "th"), or letter variation (long and short vowel "a"). Producing the phoneme is a natural part of the story as the book is read. For example, in "Peter Pops," the character, Peter, pops popcorn. On each page, he hears it, feels it, sees it pop, or tastes it. As the popcorn pops, the /p/ letter is shown popping all around the popcorn kernels and as the top lip in Peter's mouth. The accompanying text encourages readers to make the sound, that is, "Peter's ears heard it pop. P, p, p! Can yours? Books were selected on basis of the results of the Grapheme subtest of Phonological Awareness Test. Books of sounds that the participant demonstrated greatest difficulty with were chosen.

The letter "p" is found throughout the text in different word positions (initial, medial, final), in capital and lower case format, and in isolation (letters popping throughout the popcorn

kernels) and within words (the text). Thus, numerous opportunities are provided on each page to

see the letters, produce the sounds, view the words containing the sounds, hear the sentences

read, attempt to read the words, find sounds in word positions, compare words that differ by

changes in letters, and in many of the books, find the rhyming words. Thus, phonemic

awareness training can be done in the context of the meaningful text of the story. Stories vary in

complexity from very simple (as in "Peter Pops") to complex stories that follow all of the

elements of story grammar (as in "Effy's Fan). All of the stories have a surprise ending that

incorporate the phoneme/letter for that story (e.g., Peter put his lips together and the sound

popped out ... Can yours?)

All PFAS books were converted in to e-books to provide the subjects (who are not able to

hold a book or turn pages of the book due to motor disabilities) a means to independently read

the PFAS. Books were scanned and pictures were cropped and pasted into Microsoft

PowerPoint software program (Microsoft Office, 2003). Slides were created (one slide for each

page of the PFAS).

The text corresponding to each page will be typed and programmed to appear (or scroll

across the screen) using a mouse click. In addition, the investigator recorded spoke text to

appear as the text scrolled across the screen. Presentation of auditory cues assisted the

participants to pay attention to the words as they appear on the screen. Animation (motion paths

such as diagonal right movement or spin) for each of the picture was also programmed to be

activated with a mouse click. Transitions were programmed for each slide so that left mouse

clicks can be used to move from one slide to the next. A switch interface (hardware from Don

Johnston Company) was used to attach a rocking lever switch to the computer so that the

subjects could use a switch click to move from one slide to the other as well as activate the animation and start scrolling of the text.

Phonic Faces Cards: Phonic Faces (Norris, 2001) is an alphabet in which each letter is drawn within the mouth of a face to represent the lip or mouth position related to the sound associated with that letter. For example, the curved shape of the letter "P" is drawn as the upper lip of a boy's face, representing the popping motion of the lip used to produce that sound. Each letter/sound has its own face. All Phonic Faces were scanned into the computer and stored as symbols, which enabled them to be programmed to correspond with specific voice output. The Phonic Faces symbols then were inserted into appropriate overlays on the communication devices used by the subjects. The corresponding sound for each Phonic Face was recorded into the devices. The programmed Phonic Faces provided a means for subjects to select a letter in response to a letter name or sound prompt, or to indicate the sound heard within a word or associated with a letter. These responses were used throughout the intervention and in the probes measuring target skills following each session.

Probes

Five probes were given following each session. Three measured knowledge of the targeted alphabetical letters and their associated sounds; two measured awareness of the position of the letter/sound within a word (i.e., segmentation). Each probe was designed for an AAC response mode:

Probe 1: Given one of the targeted letters, the subject indicated the associated sound. The examiner pointed to 3 contrasting mouth pictures (closed lips, tongue tip elevation, open lips), pointed to the letters, and then produced the 3 sound choices. For example, the letter "m" was presented and the examiner asked, "Does this letter say "mmmm" (pointing to the closed

lips), "t" (pointing to the tongue tip), or "k" (pointing to the open lips). The order of presentation was randomized across 10 trials (5 for each letter, presented randomly).

Probe 2: Given one of the targeted sounds, the subject indicated the associated letter. The examiner produced the target sound and pointed to a choice of 3 letters, asking "Which letter makes the ___ sound?

Probe 3: Given a letter name, the subject indicated the associated letter. The examiner produced the letter name and pointed to a choice of 3 letters, asking, "Which one is letter ___?"

Probe 4: Given a written word with the target sound in an initial, medial, or final position, the subject indicated the position in which the letter was found by pointing to the initial – medial – final position on a train (engine – car – caboose). The subjects were able to demonstrate that they understood the concept of initial – medial – final using the train (i.e., "Find the beginning car," etc).

Probe 5: Given a word with the target sound in an initial, medial, or final position, the subject indicated the position in which the sound was heard by pointing to the initial – medial – final position on a train (engine – car – caboose).

Intervention Procedures

Three subjects were provided intervention for reading using a single subject across subject and alternating conditions (ABAB) design. The 2 letters and their corresponding sounds, and the segmentation of those letters from words identified at pretest were targeted during the intervention.

In Phase A1 (control condition), subjects received speech-language therapy that did not include attention to any letter-sounds, storybooks, or other literacy targets. Treatment consisted of increasing efficiency of use of the communication device and functional communication

skills. The literacy probes were administered for the final 15 minutes of the session, for a total of 4 sessions (1 week).

Phase B1 (treatment condition), was implemented for 8 sessions (2 weeks). Two letter/sounds were targeted during each treatment session, followed by the literacy probes. Both sounds were presented during the same session. One letter/sound was treated using Alphabet Stories (Pemberton, 2004) that provide direct exposure to the target letter, but only indirect exposure to the sound (i.e., words that begin with the sound), and only in the initial word position. The second letter/sound was treated using Phonic Faces Alphabet Storybooks, which more directly targeted the alphabet letter, its sound, and the position of the sound within a word. The order of presentation within the session was randomized (i.e., coin flip), with Subject SA receiving Phonic Faces first, Subject SB Alphabet Stories, and Subject SC Alphabet Stories.

Return to Phase A (A2): The speech therapy with no focus on literacy condition then was reintroduced for 1 week (i.e., 4 sessions). It was hypothesized that further increases in performance would not be demonstrated.

Return to Phase B (B2): The targeted letter/sound treatment was reintroduced for the final 2 weeks of the study to determine if increases in the targeted skills would occur. The order of book presentation was reversed, so those receiving Phonic Faces first would now receive Alphabet Stories first, and vice versa. The alphabet letter/sound also was reversed, so that the letter that had been treated using a Phonic Faces book was now addressed using an Alphabet Story and vice versa.

The test battery was repeated at posttest to determine if increases were demonstrated in the targeted skills, and whether additional incidental learning occurred on skills not targeted but part of the book reading (i.e., rhyme).

The following format was used during the intervention sessions for the Alphabet Storybook part of the session. The Alphabet Story was read for approximately 10-12 minutes of each session as follows:

a. The investigator introduced the Alphabet Story e-book to the subject on the computer. The investigator pointed to the letter and named it when it occurred within the story.

b. Each pictionary page was read and when the bold face words or letter were encountered, the investigator pointed to the word, associated the word with the picture, named the word or letter, and produced the sound associated with the letter. This procedure was followed until all 11 of the pictionary pages were read.

c. Subjects were allowed to use arrow keys or a switch to turn the page of the e-book, or to return to a desired page to reread the text.

The format used during the 10-12 minute portion of the session included The Phonic Faces Alphabet Storybooks corresponding to the target letters. These books were read in the following manner:

a. The investigator introduced the adapted PFAS on the computer. As a page is turned, the words scroll onto the page and are read electronically (i.e., "Emmett said, 'mmmm,' and magically …"). On each page the investigator pointed to the Phonic Faces character with the letter shown producing the sound, and the investigator produced the associated sound while pointing to the letters.

b. The subject then was encouraged to find other examples of the target letter in words. The investigator either scrolled the words until the subject touched a switch to stop, or pointed to the words as asked if the subject could find the target letter in the word. The

investigator then read the word, exaggerating the target sound (i.e., "mmmmagically" has

letter "m").

c. The subject was provided the train cars used in the probe and asked to tell whether the

letter/sound occurred at the beginning, middle, or ending of the word by pointing to the

engine, car, or caboose.

d. Subjects were allowed to use arrow keys or a switch to turn the page of the e-book, or to

return to a desired page to reread the text.

Following the 2 readings, five probes were administered and recorded.

Reliability

The pretest and posttests, as well as 3 sessions (baseline, Phase B1 and Phase B2) were

video recorded. A second rater (a certified speech language pathologist) scored the tests and

probes from the video recordings to determine inter-rater reliability. Treatment fidelity was also

assessed. An individual naive to the study was asked to view the treatment conditions and rate

the on-task time, enthusiasm, and attention to the target sound during both storybook treatments

to assure fidelity of the intervention sessions. A detailed description of the results of these scores

is included in the results section.

Pre/post Test Data Analysis

A repeated ANOVA conducted to compare performance on the formal and informal

subtests. A repeated ANOVA will be used to compare the 3 measures on the Informal Reading

Inventory as well as the 7 subtests of the Phonological Awareness test between pre and post

testing. The gain in the pre/post test scores was also checked against the standard error of

measurement for the Phonological Awareness Test. According to the test manual, the standard

error of measurement is 1 for all subtests except for contextual conventions (for which it is 2). This helps to rule out other factors that might cause a gain in the posttest scores.

Data Analysis of Daily Intervention Sessions

Results from the daily intervention sessions were analyzed using (a) visual analysis, (b) assessing trends and levels between adjacent phases and (c) a paired t-test analysis.

a. Results from the 5 probes were plotted on a graph and the gain analyzed visually in terms of increase in scores after intervention as compared to the scores before intervention.

b. Change in trend (or change in direction such as acceleration) was used to determine the effect of intervention.

c. Change in level (or change in value or magnitude) of scores before and after intervention were used during data analysis.

d. Paired t-test was used to determine significant in the difference between the scores for the first intervention phase using Phonic Faces Story books vs. Alphabet books.

RESULTS

Pretest and posttest measures of phonological awareness were obtained for all 3 subjects

using formal and informal procedures. These included The Phonological Awareness Test

(Robertson & Salter, 1997) and The Informal Reading Inventory, 8th edition (Burns & Roe,

2006). Five probes were used after each session to compare subject performance during baseline

and intervention phases. Three probes measured the subjects' knowledge of the targeted

graphemes (letters and their sound associations) whereas the last two probes measured the

awareness of the position of the targeted letters and sounds in different positions in words.

Standardized Test Performance Pre-Posttest

To determine whether the subjects with severe speech and language disorders performed

better with phonological awareness after exposing them to print and print input using an e-book

format, the mean pretest and posttest test raw scores for grapheme knowledge and decoding

skills were compared using 7 different subtests of the Phonological Awareness Test (Roberson &

Salter, 1997). Inspection of means showed that higher scores were achieved at posttest for all

measures. From the table, it is apparent that there was an increase in all subtests scores at

posttest. To determine if these means were reliably different, repeated measures ANOVA was

used to test for significance. Table 4 profiles the percentile rank, standard deviations and the

gain scores in standard deviations (s.d.) obtained from the norms for The Phonological

Awareness Test (Roberson & Salter, 1997) for all three subjects.

Examination of standard scores revealed that all 3 subjects increased their performance on all 7

subtests. Subject SA improved in general from the poor range on all subtests to the average; Subject SB

from the very poor or poor range to average or slightly below; Subject SC improved from generally poor

or below average range to average on all subtests. Their gain scores in standard deviations ranged from

+1.0 to +2.9 s.d., representing a clinically significant change.

Table 4
Comparison of Pretest and Posttest Scores for 7 Subtests of The Phonological Awareness Test
for Three Subjects with Severe Delay in Expressive Language Skills.

	Subject A			Subject B			Subject C		
Dependent Variable	Pre Test	Post Test	Gain in s.d.	Pre Test	Post Test	Gain in s.d.	Pre Test	Post Test	Gain in s.d.
Rhyming									
Percentile rank	9	70		3	15		2	48	
Standard scores	72	110	+2.6	61	88	+1	71	106	+2.4
Segmentation									
Percentile rank	9	88		5	38		4	83	
Standard scores	73	115	+2.8	74	97	+1.5	72	115	+2.9
Isolation									
Percentile rank	9	61		7	33		21	52	
Standard scores	71	109	+2.6	74	97	+1.5	83	99	+1
Deletion									
Percentile rank	8	33		6	37		7	46	
Standard scores	75	95	+1.4	73	96	+1.4	74	97	+1.7
Substitution									
Percentile rank	9	65		8	39		28	74	
Standard scores	83	103	+1	76	96	+1.5	90	106	+1
Blending									
Percentile rank	7	46		3	14		3	47	
Standard scores	77	104	+1.6	59	88	+2	63	99	+2.5
Graphemes									
Percentile rank	7	61		3	24		20	47	
Standard scores	69	108	+2.6	58	93	+2.3	81	98	+1

To determine if the standard scores gains represented a statistically significant change; results were

subjected to a repeated measure ANOVA. Table 5 profiles the mean standard scores and standard

deviations for the three subjects for each of the seven subtests of the Phonological Awareness Test.

Using the Bonferroni correction (Bonferrroni, 1935), the alpha level of each individual test was adjusted

downwards (to 0.01) to ensure that the overall experiment-wise risk for a number of tests remained at

0.05.

Table 5

Profile of Means, Standard Deviations, and Results of Repeated Measures ANOVA for 7 Subtest
Scores of the Phonological Awareness Test

Dependent Variable	Pretest	Posttest	F	sig
Rhyming				
M	67.67	97.33	292.74	.003
SD	4.72	13.01		
Segmentation				
M	77.00	107.77	623.12	.002
SD	9.00	7.00		
Isolation				
M	73.00	96.00	306.25	.009
SD	1.00	1.50		
Deletion				
M	75.33	100.00	288.21	.003
SD				
Substitution				
M	58.67	79.67	355.84	.003
SD	5.69	7.37		
Blending				
M	63.33	90.00	256.74	.004
SD	12.21	12.86		
Graphemes				
M	64.33	90.00	121.00	.008
SD	14.57	12.12		

The results of the ANOVA indicate differences between the scores are significant ($p<0.05$).

These results indicate that the subjects at posttest following intervention exposure to print and

print input displayed better use of rhyming (discrimination and production), segmentation,

isolation, deletion, substitution and blending of sounds, and sound/symbol correspondence.

Non-standardized Test Performance Pre-posttest

To determine whether the subjects with severe speech and language disorders performed

better with reading comprehension and word recognition after exposing the students to print and

print input using an e-book format, the mean pretest and posttest test scores for word recognition,

oral and silent reading comprehension were compared. Inspection of means showed that higher

scores were achieved at posttest for all measures. From the table, it is apparent that there was an

increase in all subtests scores at posttest. To determine if these means were reliably different,

repeated measures ANOVA was used to test for significance. Table 6 compares the pre and

posttest error scores for word recognition, silent reading comprehension and listening

comprehension of all three subjects.

Table 6
<u>Comparison of Pretest and Posttest Scores for Word Recognition, Silent Reading and Listening
Comprehension Subtests of the Informal Reading Inventory for all Three Subjects with Severe
Expressive Language Skills.</u>
_____

	Subject SA		
Dependent Variable	Pre Test	Posttest	Reading Level
Word recognition (% correct)	20	40	Below Pre-primer
Listening comp. (% correct)	32	53	Below Pre-primer
Silent reading (% correct)	25	35	Below Pre-primer

_____

	Subject SB		
Dependent Variable	Pre Test	Posttest	Reading Level
Word recognition (% correct)	30	45	Below Pre-primer
Listening comp. (% correct)	35	63	Below Pre-primer
Silent reading (% correct)	37	56	Below Pre-primer

_____

	Subject SC		
Dependent Variable	Pre Test	Posttest	Reading Level
Word recognition (% correct)	10	30	Below Pre-primer
Listening comp. (% correct)	28	37	Below Pre-primer
Silent reading (% correct)	13	45	Below Pre-primer

Table 7 profiles the results of the repeated measures ANOVA on pre and posttest error scores

for the three subjects for each of the three subtests of the Informal Reading Inventory. Using the

Bonferroni correction (Bonferrroni, 1935), the alpha level of each individual test was adjusted

downwards (to 0.01) to ensure that the overall experiment-wise risk for a number of tests

remained at 0.05.

Table 7
Comparison of Pretest and Posttest Error Scores for 3 Subtests of the Informal Reading
Inventory for Three Subjects with Severe Speech and Language Disabilities.

Dependent Variable	Pretest	Posttest	F	sig
Word recognition				
M	20.00	38.33	130.00	.008
SD	10.00	7.63		
Listening comprehension				
M	35.00	51.00	138.51	.009
SD	8.89	13.11		
Silent comprehension				
M	25.00	45.33	121.00	.008
SD	7.57	10.50		

The results of the ANOVA indicate differences between the scores are significant

(p<0.05). These results indicate that the subjects at posttest following intervention exposure to

print and print input displayed better use of silent reading comprehension, oral reading

comprehension, and word recognition.

Analysis of Session Probes

Five probes were administered immediately following each intervention session. The

first three probes compared subject knowledge of the targeted letters and their sounds. The last

two compared the subjects' awareness of the letter or the sound in different positions in words.

Scores from the probes were compared across subjects. To determine if there were reliable

differences between the Phonic Faces and the Alphabet book conditions, the two sets of scores

from the first intervention phase (B1) were subject to a paired t-test for each probe administered

after each session. Phase B2 revealed whether additional improvement in either target letter

occurred when the instructional condition changed and was addressed through visual inspection of the results.

During the baseline sessions, the subjects were not provided instruction using any targeted graphemes (letters and their associated sounds) identified during the pretest. Therapy during those sessions focused on other language skills (e.g., increasing rate of interaction during social communication). During the first intervention phase, one of the target grapheme (chosen randomly) was subject to Phonic Faces Storybook (PFSB) intervention whereas the second targeted grapheme was subject to intervention using the Alphabet book. The intervention was reversed during the second intervention stage. The grapheme initially subject to Phonic Faces Storybook was now subject to the Alphabet Storybook and the grapheme subjected to the Alphabet Storybook was now subject to intervention from the Phonic Faces Storybook. The graphemes used with the subjects are shown in Table 8.

Table 8
Graphemes Identified for Intervention with Subjects with Severe Speech and Language Disabilities.

Subject	1st intervention phase		2nd intervention phase	
	PFSB	Alphabet book	PFSB	Alphabet book
SA	/k/	/s/	/s/	/k/
SB	/r/	/t/	/t/	/r/
SC	/p/	/t/	/t/	/p/

Subject SA: Analysis of Probe Results

Five probes were administered to determine if the effect of Phonic Faces intervention was greater than the alphabet books intervention. The probes were administered during baseline as

well as during the intervention phases. The results of these probes for subject SA are profiled in
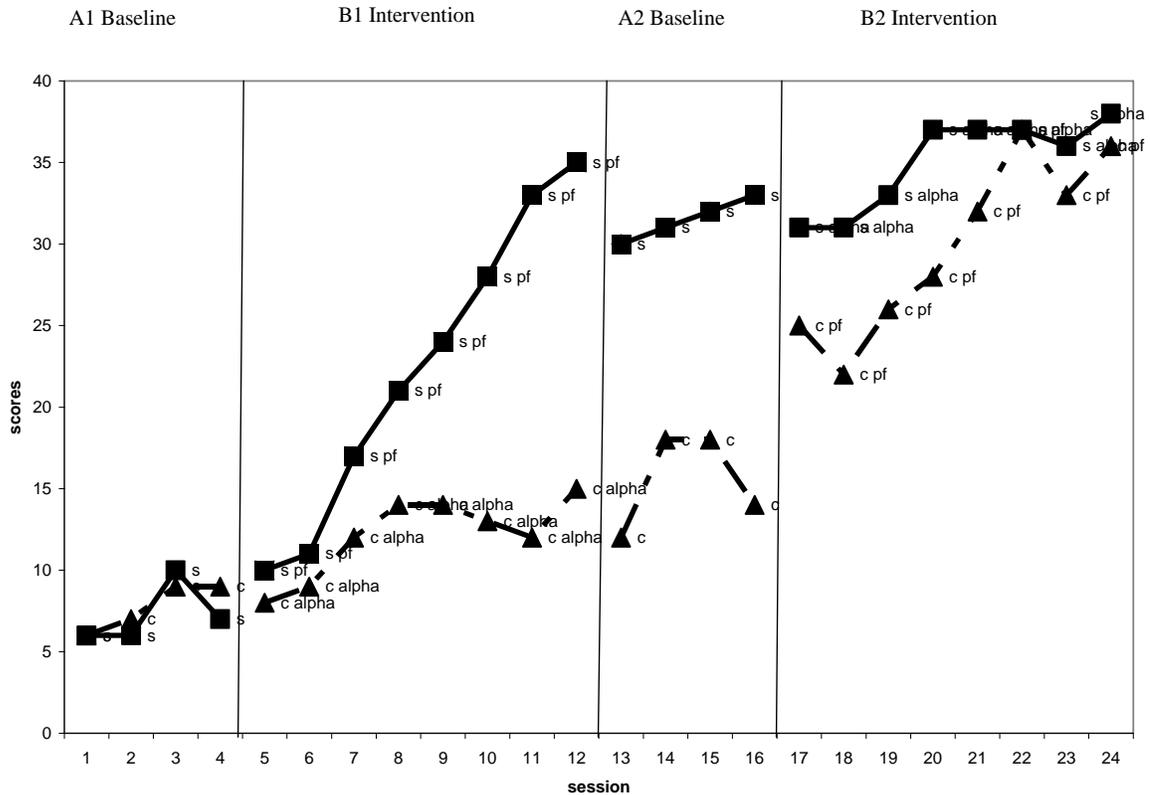
Figure 3.

Figure 3
Comparison of all Five Probe Scores of Subject SA for Baseline and Intervention Phases Under
Conditions of Phonic Faces Storybooks versus Alphabet Storybooks

Visual inspection shows that a slight increase was noted in the scores during A1 baseline

from 5 to 10 points. During the first intervention phase (B1); however, scores for the grapheme

subject to Phonic Faces Story Books increase a much greater rate from approximately 8 to 35

points. Although an increase was noted for the grapheme subject to the Alphabet Story Books

the increase was at a much slower rate (from 6 to 15 points). When intervention was withdrawn

during second baseline phase (A2) a slight drop was noted (from 30 to 35 points) for the

grapheme subject to Phonic Faces Storybooks; however, the learning established in phase B1

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continued to be demonstrated. The sound subject to Alphabet Storybooks; however, stabilized to

scores between 10 and 15 points during phase A2. During the final phase (B2) when

intervention for the graphemes was reversed the scores for the graphemes subjected to Phonic

Faces in the first intervention phase (B1) and now subjected to the Alphabet Storybooks showed

a slight improvement (from 30 to 38 points) reaching almost mastery levels. The graphemes

subjected to Alphabet Storybook in first intervention phase (B1) and now subjected to Phonic

Faces Storybook increased to approximately the same level as the phase B1 or Phonic Face

condition (i.e., near mastery). The raw scores for the first intervention phase were subjected to a

paired t-test. These scores are profiled in Table 9.

Table 9
Comparison of Scores During First Intervention Phase (B1) for all Five Probes for Subject SA

Dependent Variable	PFSB	Alphabet book	t	sig
SA				
M	22.38	12.13	3.8	.007
SD	9.41	2.47		

The results of the paired t-tests indicate differences between the scores are significant

(p<0.05). These results indicate that there was great improvement for all probes for subject SA

with the use of Phonic Faces Storybooks as compared to those for Alphabet Storybooks.

Subject SB: Analysis of Probe Results

To determine if the effect of Phonic Faces intervention was greater than the alphabet

books intervention, five probes that evaluated phonological awareness skills were used. The

probes were administered during baseline as well as the intervention phases. The results are
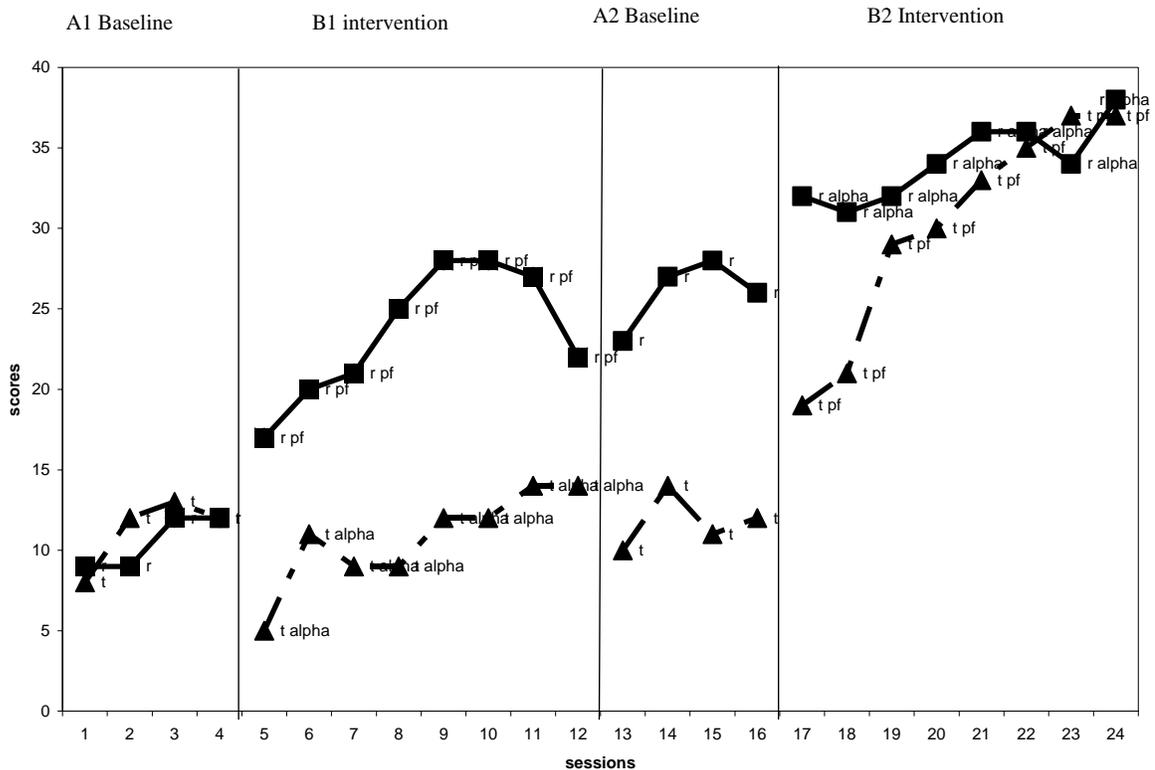
profiled in Figure 4.

Figure 4
Comparison of all Five Probe Scores of Subject SB for Baseline and Intervention Phases Under
Conditions of Phonic Faces Storybooks versus Alphabet Storybooks

Visual inspection shows that subject SB demonstrated similar results when compared to

subject SA. A slight increase was noted during first baseline phase (A1) from 8 to 12 points for

both graphemes. During first intervention phase B1, a gradual but steady increase in scores was

demonstrated during the first intervention phase (B1) for both graphemes; however, the scores

for the grapheme subjected to Phonic Faces Storybook increased a greater rate. An increase of

15 to 28 points observed for Phonic Faces Storybook as compared to 5 to 12 points for the

Alphabet Story books. These levels were maintained for both graphemes during the second

baseline (A2).   During the second treatment phase (B2), the scores for both the graphemes

increased and equalized to a near mastery level near the end of the phase, although the grapheme

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now subjected to Phonic Faces condition (formerly subjected to Alphabet storybooks) achieved results more rapidly.

The scores for the first intervention phase were subjected to a paired t-test. These scores are profiled in Table 10.

Table 10
Comparison of Scores During First Intervention Phase (B1) for all Five Probes for Subject SB

Dependent Variable	PFSB	Alphabet book	t	sig
SB				
M	23.5	10.75	11.44	.000
SD	4.11	3.01		

The results of the paired t-tests indicate differences between the scores are significant (p<0.05). These results indicate that there was greater improvement for all five probes with the use of Phonic Faces Storybooks as compared to those for Alphabet Storybooks.

Subject SC: Analysis of Probe Results

Same five probes were administered to subject SC to determine the effect of Phonic Faces Storybooks vs. Alphabet Storybooks. The probes were administered in a similar manner during baseline and intervention phases at the end of each session. The results are profiled in Figure 5.

Visual inspection reveals that subject SC demonstrated similar results to subjects SA and SB. Scores in the first baseline phase (A1) increased slightly for both graphemes (from 6 to 13 points). In the first intervention phase (B1), the scores for both targeted graphemes increased; however, the increase in scores for the grapheme subjected to Phonic Faces Storybook did better than the grapheme subject to Alphabet Storybooks. In the second baseline phase (B2), the scores for the targeted graphemes decreased slightly initially but then increased again. Scores for the

grapheme subject to Phonic Faces stabilized at 24 points whereas the grapheme subjected to Alphabet Storybooks increased to 17 points. During the final intervention phase (B2), the scores for the grapheme now subjected to Alphabet Storybooks (formerly subjected to Phonic Faces Story books) stabilized around 30 points whereas the grapheme now subjected to Phonic Faces (formerly subjected to Alphabet Storybooks) increased from 20 points to the same level of 30 points.

Figure 5
Comparison of all Five Probe Scores of Subject SC for Baseline and Intervention Phases Under Conditions of Phonic Faces Storybooks versus Alphabet Storybooks

The first intervention phase was subjected to a t-test to determine whether the scores of the sound subject to Phonic Faces Storybooks were better than the scores for the alphabet book. Table 11 profiles the results of the t-test.

Table 11
Comparison of Scores during First Intervention Phase (B1) for all Five Probes for Subject SC

Dependent Variable	PFSB	Alphabet book	t	sig
SC				
M	25.25	13.50	7.55	.000
SD	4.59	1.93		

The results of the paired t-tests indicate differences between the scores are significant (p<0.05). These results indicate that there was greater improvement for all probes with the use of Phonic Faces Storybooks as compared to those for Alphabet Storybooks.

Reliability:

Pretest and posttest reliability was determined using a certified speech language pathologist. In addition fidelity of intervention sessions was determined using a person naive to the research study.

Pretest and Posttest Reliability: The pretest and posttests, as well as all intervention sessions (first and second baseline, as well as first and second treatment phases) were video recorded. A second rater (a certified speech-language pathologist) scored the results of the tests and 20% of the probes from the video recordings to determine inter-rater reliability. Reliability was calculated by finding the percentage of agreement between the scores obtained by the speech language pathologist and the primary investigator. Table 12 profiles the reliability scores on each of the subtests of The Phonological Awareness Test, the Informal Reading Inventory, and the baseline, first and second treatment phases. The scores demonstrate high rate of agreement between the primary investigator and the second rater.

Table 12

Reliability of scoring for the 7 subtests of the Phonological Awareness Test, the Informal
Reading Inventory, Baseline, and First and Second Treatment Phases

Instrument	Inter-rater Reliability
The Phonological Awareness Test	
Rhyming	92.31
Segmentation	95.25
Isolation	94.35
Substitution	90.11
Deletion	91.21
Blending	94.23
Graphemes	95.65
Informal Reading Inventory	
Word recognition	91.35
Silent reading comprehension	92.21
Oral reading comprehension	92.34
Baseline	87.76
First treatment phase	88.76
Second treatment phase	89.11

Treatment Fidelity

Treatment fidelity was assessed using an individual naive to the study to view the

treatment conditions and rate the on-task time, enthusiasm, and attention to the target sound

during both storybook treatments to assure the fidelity of the intervention. The naïve observer

was asked to score treatment session with Phonic Faces Storybooks as well as the alphabet

storybooks and to note the on-task time in minutes, and to rate the enthusiasm and attention to

the target sound on a five point Likert scale (with 1 being least enthusiastic/attentive and 5 being

greatly enthusiastic/attentive). The following table demonstrates the average scores obtained on

each of the phases.

Table 13

Fidelity Scores of Naïve Individual Comparing Researcher Enthusiasm, Attention to sounds, and On-task behaviors

	Treatment phase 1		Treatment phase 2	
	Phonic Faces bks	Alphabet bks	Phonic Faces bks.	Alphabet bks
Enthusiasm	4	4	4	5
Attention to sound	5	4	4	4
Time on task	13 min	12 min	15 min	12 min

Summary

The analyses of measures of reading ability between pretest and posttest revealed significant improvement for all three subjects. Each subject improved in phonological awareness abilities (a skill highly correlated with success in reading), and in passage word recognition and comprehension. This finding indicates that this population of non-verbal children using a communication board can benefit in a relatively short period of time from instruction using e-books. The single-subject design resulted in all subjects receiving instruction using both the Phonic Faces and traditional alphabet, so that the source of the increases could not be identified.

To determine if the Phonic Faces approach held greater efficacy for this population, a series of probes were used to compare responses for the letter learned using the Phonic Face versus the traditional alphabet. For all 5 probes, the response to the letter learned using the Phonic Face e-book was reliably better than the letter learned using the traditional alphabet e-book at the end of the first intervention phase. Following a second baseline (B2), the letter taught in phase B1 using the Phonic Face continued to increase to mastery or near mastery by the end of phase B2 even though that letter now was taught using the traditional alphabet. The letter

taught in phase B1 using the traditional alphabet was taught using the Phonic Faces e-book during phase B2. In all cases, response to the letter rapidly improved once the Phonic Face was introduced, and the letter reached a level of mastery or near mastery by the end of the phase. These results indicate that the Phonic Faces e-books presented a more efficacious context for letter and sound learning for all 3 subjects.

DISCUSSION

No Child Left Behind (2001) mandates that all children be taught to read, yet little time is typically spent in teaching literacy to children who are concomitantly severely speech and language impaired, non-verbal, and who have not yet mastered oral communication skills using AAC devices. This study took a beginning step toward showing that literacy instruction for this population can have positive results in a relatively short period of intervention. Importantly, the study was conducted during the summer when the children were not in school and were not receiving literacy instruction from other programs. The study also demonstrated that the materials used make an important difference in the attitude and success of these children as they attempt to understand the conventions and skills related to reading.

Improvements in Phonological Awareness

Much of the current literature points to phonological awareness as being a key skill in learning the alphabetic principle of letter-sound association and learning to decode words. Researchers have demonstrated that users of AAC overall display poor phonological awareness skills (Foley, 1999; Dahlgren-Sandberg, 2001; Vandervelden & Siegel, 2001) and attribute this in part because they are unable to actually produce the sounds due to oral motor difficulties (Beukelman & Mirenda, 2003; Strum, Spadorica, Cunnigham, Cali, Staples, Erikson, Yoder & Koppenhaver, 2006). In this study, all three subjects increased their performance on all 6 phonological awareness subtests of the Test of Phonological Awareness (T-PAT) following 24, 1-hour intervention sessions. The results were not only statistically significant, but also clinically significant in that their gain scores resulted in from +1.0 to +2.9 standard deviations in change. At pretest, the subjects all performed in the very poor to poor range on the majority of the subtests (4 scores were in the below average range), while at posttest all scores had improved

to the average or near average (quotient scores of 88 for 2 subtests) range. This finding is remarkable in that many poor readers are trained in phonological awareness skills for months or even years without attaining average scores. The finding was true for the child with Downs Syndrome as well as the children with cerebral palsy. Importantly, the cognitive and receptive language scores for all three children were in the average to low average range, and similar changes may not be expected for children more cognitively impaired or with delayed receptive language skills.

The dramatic increase in improvement in phonological awareness suggests several things. First, it suggests that these 3 children were delayed because of lack of exposure rather than an inherent learning disability or auditory processing deficit affecting phonological awareness. Once exposed, a range of phonological awareness skills improved, even though only 1 (sounds in word position) was specifically targeted for treatment. Secondly, a wide range of skills improved that require phonological manipulation. To score in the average range the subjects needed to substitute, delete, segment, isolate, blend, and rhyme sounds within multiple words at increasing levels of phonological complexity (CVC, CCVC, and 2-3 syllables). This suggests that they were organizing the knowledge they were acquiring regarding sounds and letters in a manner consistent with hierarchical organization and not just memorizing responses to tasks. Thirdly, the skills were learned in context rather than in isolation. While talked about incidentally in context, they were acquired without extensive practice and drill suggesting that the abilities are the outcome of the self-organizing process that occurs whenever language is learned. Finally, it calls into question the premise that children with severe speech and motor impairments perform poorly on phonological awareness tasks because they are unable to actually produce the sounds due to oral motor difficulties (Beukelman & Mirenda, 2003; Strum,

Spadorica, Cunnigham, Cali, Staples, Erikson, Yoder & Koppenhaver, 2006). In this study, the students did not improve on oral motor productions, yet rapidly improved on phonological awareness. This finding suggests that some process other than oral motor production is key to phonological awareness.

The question of whether the iconic visual representation of sound production provided by the Phonic Faces would contribute to better phonological awareness was addressed by five probes used at the end of each session. In these probes, subjects were required to identify not only letter to sound and sound to letter association but also the position of a target sound and letter within a word position (initial, medial, final) for orally presented words. For all 3 subjects, identification was better for the sounds worked on using the Phonic Faces book than the alphabet book. The results were significant for all word positions. Examination of daily probe profiles shows that correct identification of sounds for the Phonic Faces target increased almost immediately during the first intervention phase (B1) and reached a level near mastery by the end of the first phase. Changes occurred at a much slower rate for the sound subject to the Alphabet books until the second intervention phase (B2) when that sound now was treated using Phonic Faces books. During the second intervention phase (B2) however, rapid changes were observed until mastery or near mastery was achieved. These results imply that the iconic visual representation of the Phonic Faces did help students become more meta-aware of sounds and the canonical structure of sounds within words. The continued increase of the sound initially taught using Phonic Faces but switched to the alphabet condition during the second phase (B2) suggests that once the principle was understood, it generalized.

Not only did it generalize to the sound targeted in the intervention, but also to sounds in general as reflected by changes in scores on The Phonological Awareness Test (T-PAT). The

Sounds in Isolation subtest measures similar abilities to the probe, and standardized performance went from poor or below average (quotient scores of 71, 74, and 83) to average (109, 97, and 99) for all 3 subjects following intervention.

Improvement in Grapheme Knowledge

While phonological awareness is important to the reading process, reading cannot develop until the child is able to merge internalized knowledge about the sound structure of words to the symbolic visual representation of letters. Knowing the alphabet accounts for more unique variance in learning to read than does phonological awareness (Johnson, Anderson, & Holligan, 1996). Several measures of alphabet knowledge were addressed in this study including a standardized subtest from the T-PAT and probes.

The Grapheme subtest of the T-PAT requires children to say the sound associated with a written consonant letter. At pretest all three subjects were low, with standard ratings of very poor for subjects SA and SB and below average for subject SC (Standard Score of 69, 58, and 81, respectively). At posttest, all subjects improved to scores in the average range (108, 93, and 98). These results were not only statistically significant, but also clinically significant in that their gain scores resulted in from +1.0 to +2.6 standard deviations in change. Once exposed, a range of letter-sounds were learned even without specific instruction.

The question of whether the iconic visual representation of letter-sound association (provided by the Phonic Faces) would contribute to better alphabet knowledge was addressed using Probes 1 through 4. Probe 1 was similar to the T-PAT task, where when given a letter the child was required to choose the associated sound from a choice of 3. The letter-sound taught using Phonic Faces began to change immediately during the first intervention phase (B1) and reached near mastery, while the alphabet letter slowly increased for 2 subjects and decreased for

the third. When the conditions were reversed, the letter-sound originally taught using the

alphabet book immediately increased when the Phonic Faces book was introduced and reached a

level near mastery by the end of the phase.

Probe 2 reversed the task; given a sound, the child was expected to find the

corresponding letter. The results paralleled those of Probe 1. The sound-letter association

showed an immediate increase under the Phonic Faces condition during the first phase (B1) to

near mastery, and maintained this level even when read within an alphabet book during phase

B2. The alternate sound-letter association initially taught using an alphabet book did not

increase during intervention phase B1 for any subject, but immediately started to increase and

reached a mastery level by the end of Phase B2 after the Phonic Faces condition was initiated.

The finding that the same profiles occurred for all 3 subjects across letter-to-sound and sound-to-

letter tasks in classic ABAB patterns provides strong evidence that the visual iconic

representation of the Phonic Faces letter and storybooks do provide cues that are needed and

readily used by children with low verbal and low literacy experience to learn these associations.

The differences for both probes were statistically reliable.

Probe 3 required the child to identify the letter associated with a letter name from a

choice of 3. Two of the subjects recognized letter names with fair reliability during the first

baseline (A1) and increased their scores the most when the Phonic Faces condition was

employed. The third subject was less reliable at baseline (A1) but increased to near mastery with

greater progress when the Phonic Faces were used. The differences were significant. This finding

indicates that although letters and sounds were a strong focus of the intervention, children also

acquired the names for letters as letter-sound associations were learned. Because more letter

names than sound associations were known at baseline (A1), it also suggests that learning a name

for an alphabetic symbol is easier than learning what it signifies. However, knowing the name generally does not help with phonological awareness or decoding unless children recognize the relationship between the letter name ("tee") and the first sound of this letter name (many, such as "eff" "gee" "aich" do not maintain this principle).

Probe 4 is similar to the phonological awareness probe except it focused on letter awareness. Given a written word, children were to indicate whether the target letter occurred in the initial, medial, or final position. Thus, the task required both phonological awareness and letter-sound association. As predicted from the phonological awareness findings, all subjects performed consistently poorly on this task at baseline (A1). Performance increased dramatically for all 3 subjects under the Phonic Faces condition during Phase B1 and was maintained, and another dramatic increase was seen for the second letter once switched to Phonic Faces during Phase B2. By comparison, small and inconsistent changes were seen for that letter when treated using the alphabet book during the first intervention phase (B1). This finding supports the suggestion that the Phonic Faces provide a bootstrap for children to learn and understand letter, sound, and word relationships within a hierarchical mental structure. When the concepts were introduced using letters embedded in alphabet books, little or no understanding of the concept was demonstrated and change regressed for some during the second baseline (A2). When the concepts were introduced using the Phonic Faces iconic representation, immediate changes in performance for both letter-sound and letter/sound in word position were seen and maintained even when the Phonic Faces were withdrawn. This indicates that once the principle was understood, the children did not rely on the Phonic Faces representation, but rather generalized response to the letter itself without specific training or fading techniques. Fewer than 5 sessions were required to learn sound to letter relationships.

Improvements in Reading

The improvements in phonological awareness and alphabet skills are a good beginning step, but the goal for children with severe language delays and physical impairments is to improve in their actual reading skills. An Informal Reading Inventory administered pre and post intervention revealed significant changes for the subjects for word recognition, silent reading comprehension and listening comprehension. All subjects tested below the preprimer reading level at pretest, recognizing only 2-6 words from the preprimer high frequency word list and demonstrating comprehension in the frustration range, even when the passages were read to them. At posttest word recognition increased to 6-9 words although word recognition was not specifically worked on. It can be hypothesized that either repeated reading of the storybooks in e-book format where words scrolled on the screen as they were heard, or emerging decoding skills due to improved phonological awareness and alphabet knowledge, or a combination of both led to these changes. A study comparing e-books that scrolled words versus the Phonic Faces books that also focused on phonological and letter skills would be needed to parse these possibilities.

All three subjects showed poor comprehension at pretest, even for listening skills, which was surprising in that they demonstrated average cognitive and receptive language skills in other assessments. It is possible that the longer passages of the reading task compared to the short questions on other tests contributed to the low performance. It also is possible that the children were unfamiliar with the multiple choice test formats, and the task interfered with comprehension. A third possibility is that comprehension of discourse is a weakness for children with severe speech and physical impairments that has not been recognized in the extant research. This could be as a result of lack of exposure, especially through reading, or even lack

of experience playing out long connected sequences of imaginative play. These results suggest

that the narrative comprehension abilities of this population require further study.

At posttest all 3 subjects improved in both listening and silent reading comprehension.

Subjects SA and SB increased performance to the lower ranges of instructional comprehension

for listening to passages read, while Subject SC improved but remained at the frustration level.

Subject SB, who had the highest scores at pretest, also improved to the lower ranges of the

instructional level for silent independent reading, while Subjects SA and SC improved but

remained in the frustration range.

Benefits from Exposure to Print Material and Efficacy of E-Books

While the relative efficacy of teaching alphabetic and phonological awareness principles

in isolated discrete trials versus in a storybook context was not a question of this study, the

results do show that these skills can successfully be learned in context. This finding is consistent

with Goodman (1996) as well as Musselwhite and King-DeBaun (1997) who propose that

reading, writing and verbal expression operate together to form language and is best learned in

context. Musselwhite and King-DeBaun (1997) specifically indicate that non-speaking children

should be exposed to all aspects of language at an early age, and that phonetics or letter-sound

associations be embedded naturally and meaningfully into teaching techniques.

The present study used adapted storybook reading as a naturally and meaningfully

occurring activity to teach phonological awareness. Phonic Faces Storybooks teach graphemes,

not in an isolated skill and drill manner, but integrating them into the context of stories and

storybook reading. When a child is exposed to text within the context of storybook reading, the

orthographic patterns of a word are related to the sound patterns of the word as well as to the

meaning of the word within the text. This helps the child to internalize the patterns used to form

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words, and these patterns can be applied to pronounce and produce new. The use of Phonic

Faces Storybooks provided this context for internalizing grapho-phonemic patterns, which could

then be generalized to new sounds and letter patterns.

Anecdotally, after being exposed to the Phonic Faces Storybooks, all three subjects tried

to imitate the sounds. It was reported by parents and caregivers of all the three subjects that the

children were more vocal. Even though subjects (SA and SB) have extremely dysarthric speech

and are able to produce only a few word approximations, they began to imitate some of the target

sounds used in the study. The speech language pathologist working with one of the subjects

(SC) reported considerable improvement in the use of bilabial sounds /p/ during articulation

therapy. In addition, the same subject (SC) also engaged in vocal play at other times during the

day when not working with the Phonic Faces.

All the three subjects in the study demonstrated a preference for the Phonic Faces

storybooks. No fussing or whining was associated with the Phonic Faces Storybooks whereas

after the first two or three sessions with the Alphabet Storybooks, the children showed disinterest

and would request the use of the Phonic Face Storybook. While reading the Alphabet

Storybooks, the children stopped responding and needed to be prompted to access the switch

after reading a few pages. However, they requested to read the Phonic Faces Storybooks over

again. Subject SC also became uncooperative while reading the Alphabet Storybooks. She often

used the phrase "no, not that," in association with the Alphabet Storybooks but used the manual

sign for "more" to request a repeated reading of the Phonic Faces Storybooks. Alphabet books

generally do not have a plot, and although the books used in this study did embed target words in

a story, the plot was minimal. The differences between learning alphabetic knowledge in the

context of alphabet books versus alphabet-focused storybooks (such as Phonic Faces

Storybooks) warrant further study.

Limited accessibility to print based materials together with low caregiver expectations are among some of the reasons given by researchers (Musselwhite & King-DeBaun, 1997, Erikson, Koppenhaver & Yoder, 2002; Koppenhaver & Yoder, 1993) for low literacy levels for children who use AAC systems. Several low and high technology strategies have been suggested by different authors (Burkhart, 1993; Erikson, Musselwhite & Zialkowski, 2002; Musselwhite & King-Debaun, 1997) as solutions. Use of computers to make books accessible has been listed as one option by these authors. They view computers as the solution to many educational needs. Computers are viewed as having the ability to increase student motivation and involvement in learning. Students also appear to be motivated by the use of computers. They are motivated by the graphics, sounds and ease with which they can access information.

In this study, the use of e-books appeared to motivate the children. Although it could not be determined conclusively what effect e-books had on the literacy gains (since no control was used with regular paper books), all children were excited and motivated to work on the computer. Future studies need to be conducted that compare the use of e-books to paper books to determine the role that accessibility plays in facilitating literacy in this population.

Benefits from Use of Adapted Testing Procedures

Several authors (Erikson, 2000, Koppenhaver, 2000, Foley, 1993, Vandervelden & Siegel, 2001) have suggested poor assessment methods as one of the reasons for not being able to identify literacy knowledge of students with severe speech and physical impairments. Blischak, (1994), Foley (1993), and Foley and Staples (2003) suggested that students with severe communication and physical impairments need specialized assessment to assess their

phonological awareness. Traditional methods used to assess phonological awareness may not be appropriate for children who have severe communication and physical impairments, since they may not be able to say the sounds or words as required by phonological awareness tests. They are also unable to verbally produce words that rhyme or blend sounds together and verbally produce the resulting word.

This study used non-verbal responding strategies while administering the standardized and non-standardized pre and posttest procedures. Rhyming, blending, segmentation and graphemes were assessed using a correct answer with foils on a choice board. Participants used eye gaze or pointing to respond to the correct answers. Identification of sounds and letters in different position in words were assessed using a train to identify initial, medial and final position in words. Word recognition and oral and listening comprehension were also assessed using similar procedures. Correct answers with foils placed on a choice board and the participants were required to respond using eye gaze or pointing.

This procedure was effective in obtaining a good estimate of the participant's phonological skills, word recognition, and oral and listening comprehension skills. Participants were able to indicate their ability to: (a) identify and produce rhyme, (b) make letter and sound associations, (c) manipulate sounds to form words, (d) segment words into sounds, and (e) identify letter and sound position in words. Similarly, word recognition skills and comprehension skills during oral and silent reading were assessed. Studies conducted by Bristow and Fristoe (1986) and Iacono and Cupples (2004) have demonstrated that such adaptations result in reliable test scores for typically developing children.

Implications for Users of AAC Devices

Balkom and Welle Donker-Gimbrere (1996) demonstrated that the expressive language of children who use AAC devices reflect inherent restrictions in the child's AAC system. The vocabulary programmed on the AAC devices belongs to parents, caregivers and teachers and is often of little or no relevance to the child. Users of AAC devices rarely select their own lexicon for their communication displays but depend upon adults to do it for them (Beukelman, Jones & Rowan, 1989; Nelson, 1992). The external lexicon or words on the communication device may not reflect an internal lexicon or words that correspond with the thoughts of users of AAC devices (Smith, 1996; van Balkom & Welle Donker-Gimbere, 1996). Development of literacy skills is therefore very important for users of AAC systems in order to be able to communicate their own thoughts and feelings. The present study demonstrated that children with limited speech and physical abilities could learn early reading skills in a short period of time, a finding that suggests they have good potential to use print as a symbol system.

Limitations of the Study

Although the present study provided evidence regarding the efficacy of adapted Phonic Faces storybooks as a strategy to teach phonological awareness to children with severe speech and physical impairments, several limitations need to be addressed in future research. Six important limitations are identified which include: (a) use of a small number of subjects that shared a similar profile, (b) use of only two graphemes, (c) lack of a control group that used paper books instead of e-books, (d) lack of a control group that used "skill and drill" teaching strategies to develop phonological awareness skills, (e) lack of a control group that was not exposed to print materials, and (f) a comparison of use of Phonic Faces Storybooks versus Phonic Faces by themselves.

The first limitation was the small number of subjects. Because only 3 subjects were used in this research study, the results cannot be generalized to a larger population. Further, the three participants for the research study all shared the same profile. That is (a) they were all emergent readers who had some sight word vocabulary but were unable to read connected text, (b) they all had age appropriate receptive language skills, (c) they all had severely impaired expressive language skills but were proficient users of their AAC systems, and (d) they had no vision or hearing difficulties. Further research needs to be conducted with a larger population of users with AAC devices and with different profiles.

Secondly, a small number of letter-sounds (graphemes) were addressed during intervention. Although the subjects had difficulty with more than two graphemes, only two were targeted during the research study. The effects generalized quickly to other graphemes. These effects may have been generated by the specific graphemes taught, or the specific Phonic Faces books read, or other unknown factors. The study needs to be replicated using both the same graphemes and different graphemes, as well as varying numbers of graphemes. The generalization effects need to be observed to determine if this phenomena was specific to these subjects, or if it is more typical that a broad range of graphemes required specific targeting. Different ages and profiles of subjects would be important to test for the generalization effects.

Third, the efficacy of the use of e-books could not be conclusively determined since a control group was not used. Children with severe physical difficulties usually find it difficult to physically access paper books (e.g., difficulty with turning pages of the book) and therefore the books need to be adapted (e.g., using page fluffers). A study to compare the use of e-books vs. use of adapted paper books needs to be conducted to effectively determine the benefits of using e-books with children with severe speech and physical impairments. In the modern age of

technology, young children are being exposed to the computer and other electronic equipment. They therefore are usually more motivated to use the computer that provides easy access, as well as speech and animation while reading books.

Fourth, although the results of this research study suggest that storybook reading is an appropriate and important context for literacy and language learning for children with severe speech and physical impairments; further research using a control group (e.g., a skill and drill context for teaching graphemes) needs to be conducted to better and more conclusively determine if the gains are truly reflective of the use of Phonic Faces Storybooks. Although literature supports the use of a functional holistic approach to teaching phonological awareness, traditional speech and language therapy as well as classroom instruction has typically used a skill and drill approach (use of flash cards and modeling) to teaching phonological awareness. Varying degrees of success have been reported using these methods. Therefore, further research needs to be conducted to empirically determine the efficacy of appropriate intervention approaches.

Fifth, a control group with no exposure to print-based materials was not used in the research study. All three subjects were exposed to print based materials (e.g., Phonic Faces Storybooks and Alphabet books). Thus it could not be determined that it was Phonic Faces Storybooks only that caused the change in scores rather than exposure to print based materials from both the alphabet books and the Phonic Faces books. Further research is therefore recommended.

Finally, it was proposed that the representation of speech production provided by the Phonic Faces produced an iconic bootstrapping that enabled subjects to make a connection between letter shapes, sounds, and words. However, instruction was not conducted using Phonic

Faces in isolation, but rather in the context of the Phonic Faces Storybooks. Therefore, it could not be determined that it was the use of Phonic Faces that produced changes or some other factor. Storybooks may have been more motivating and better for teaching alphabet and phonological awareness than the Phonic Faces specifically. A comparison of instruction using the Phonic Faces cards in isolation versus the Phonic Faces Storybooks would more conclusively determine the efficacy of the visualizing strategies underlying the use of Phonic Faces.

Summary

The purpose of this study was to take a beginning step into answering questions about the capacity of severely impaired non-verbal children acquiring early reading skills. This goal has been met, with important implications for the critical need to prioritize literacy skills for children with severe speech and motor impairments. While many questions remain unanswered, it is clear that children with the profile presented by these subjects are excellent candidates for literacy, and instruction should begin sooner than is typically provided. The study also shows that Phonic Faces storybooks provided a better context for learning alphabetic and phonological awareness principles than a traditional alphabet book.

REFERENCES

American Heritage® Dictionary of the English Language (2000). Boston, MA: Houghton Mifflin.

AMDI, Inc. (1995). Tech Speak Communication Device. Hicksville, NY: Author.

Anderson, R., Hiebert, E., Scott, J., & Wilkinson, I. (1985). *Becoming a nation of readers: the report of the commission on reading.* Washington D.C.: The National Institute of Education.

Baker, B. (1980). *Minspeak.* Bakersville, PA: Semantic Compaction Systems, Inc.

Banajee, M., DiCarlo, C., & Stricklin, S. (2003). Determination of core vocabulary in toddlers. *Augmentative and Alternative Communication.* 4, 2, 89-97.

Bates, E., Benigni, L., Bretherton, I., Camaioni, L., & Volterra, V. (1979). *The emergency of symbols: cognition and communication in infancy.* New york: academic press.

Beringer, V., & Gans, B. (1986). Assessing word processing capability of the nonvocal, nonwriting. *Augmentative and Alternative Communiction,* 2, 56-63.

Beukelman, D., & Mirenda, P. (2003). *Augmentative and alternative communication: management of severe communication disorders in children and adults. (5th ed.).* Baltimore: Paul H. Brooks.

Beukelmann, D., Jone, R., & Rowan, M. (1989). Frequency of word usage by nondisabled peers in integrated preschool classrooms. *Augmentative and Alternative Communication.* 5, 243-248.

Bishop, K., Rankin, J., & Mirenda, P. (1994). Impact of graphic symbol use on reading acquisition. *Augmentative and Alternative Communication,* 10, 113-125.

Blachman, B.A. (1994). Early literacy acquisition: The role of phonological awareness. In G. Wallach & K. Butler (Eds.), *Language and learning disabilities in school age children and adolescents: Some principles and applications.* (pp. 251–274). New York: Macmillan.

Blischak, D. (1994). Phonological awareness: Implications for individuals with little or no functional speech. *Augmentative and Alternative Communication,* 10, 245-255.

Blockberger, S., & Johnston, J. (1997). *Children who are unable to speak vs. typical children: A comparison of acquisition of grammatical morphology.* Paper presented at the Symposium on Research in Child Language Disorders, Madison, WI.

Bloom, L., & Lahey, M. (1978). *Language development and language disorders.* New York: John Wiley.

Bloom, P., & Markson, L. (1998). Intention and analogy in children's naming of pictorial presentations. *Psychological Science*, 9, 200-204.

Bradley, L., & Bryant, P. (1983). Categorizing sounds and learning to read-a causal connection. *Nature*, 301, 419–521.

Bradley, L., & Bryant, P. (1985). *Rhyme and reason in reading and spelling.* Ann Arbor: The University of Michigan.

Bristow, D., & Fristoe, M. (1988). Effects of test adaptations on test performance. *Augmentative and Alternative Communication,* 4, 171.

Burkhart, L. (1993). *Total augmentative communication in the early childhood classroom.* Eldersburg, MD: Linda J. Burkhart.

Burns, P., & Roe, B. (2006). *Informal reading inventory (8th ed.)* Boston, MA: Houghton Mifflin, Company.

Bus, A., van Ijzendoorn, M., & Pellegrini, A. (1995). Joint book reading makes success in learning to read: A metaanalysis on intergenerational transmission of literacy. *Review of Educational Research*, 65, 1 – 21.

Catts, H., & Kamhi, A. (1999). Causes of reading disabilities. In H. Catts & A. Kamhi (Eds.), *Language and reading disabilities* (pp. 95 – 127). Boston: Allyn & Bacon.

Cazden, C. (1983). Adult assistance to language development: Scaffolds, models, and direct instruction. In R. Parker & F. Davis (Eds). *Developing literacy: young children's use of language.* Newark, DE: International Reading Association.

Cambourne, B. (1988). *The whole story: Natural learning and the acquisition of literacy in the classroom.* New Zealand: Ashton Scholastic Limited

Clark, E. (1987). The principle of contrast: A constraint on language acquisition. In B. MacWhinney (Ed.), *Mechanisms of language acquisition.* Hillsdale, NJ: Lawrence Erlbaum.

Clay, M. (1991). *Becoming literate: The construction of inner control.* Portsmouth, NH: Heineman.

Cullinan, B. (1992). *Read to me: Raising kids who love to read.* New York: Scholastic, Inc.

Cunningham, P. (1995). *Phonics they use: Words for reading and writing (2nd ed.)* New York: Harper Collins College Publishers.

Cutting B., & Milligan, J. (1991). Learning to read in new zealand. In C Kamii, M. Manning, & G. Manning (Eds.). *Early literacy: A constructivist foundation for whole language.* West Haven, CT: National Education Association Professional Library

Dahlgren-Sandberg, A., & Helmquist, E. (1996). Phonological awareness and literacy abilities in nonspeaking preschool children with cerebral palsy. *Augmenative and Alternative Communication*, 12, 138-153.

Dahlgren-Sandberg, A. (2001). Reading and spelling, phonological awareness and working memory in children with severe speech impairments: A longitudinal study. *Augemtative and Alternative Communication*, 17, 11-26.

DeLoache, J., Pierroutsakos, S., Uttal, D., Rosengren, K., & Gottlier, A. (1998). Grasping the nature of pictures. *Psychological Science*, 9, 205-210.

Don Johnston Incorporated. Swith Interface Pro. 5. Volo, IL: Author.

Doyle, J. (2002). *Phonemic awareness, phonemic awareness, phonics, and fluency phonics, and fluency.* Retrieved on April 27, 2007, from The Fear Factor Web site: http://www.fcrr.org/assessment/SLP/Joann_Phonemic_Awareness_Phonics_Fluency.pdf

Durkin, D. (1966). *Children who read early: Two Longitudinal Studies.* New York: Teachers College Press

Dynavox Systems (2004). DV-4 Communication Device. Pittsburg, PA: Author.

Dynavox Systems (2004). MT-4 Communication Device. Pittsburg, PA: Author

Ehri, L., Nunes, S., Willows, D., Schuster, B., & Shanahan, T. (2001). *The national reading panel report.* Retrieved on April 27, 2007, from http://www.nichd.nih.gov/publications/nrp/upload/smallbook_pdf.pdf.

Eisle, B. (1991). *Managing the whole language classroom.* Cypress, CA: Creative Teaching Press, Inc.

Erikson, K., Musselwhite, C., & Ziolkowski, B. (2002). *Beginning literacy framework.* Retrieved on April 27,2007 from http://www.donjohnston.com/research/beg_lit_framework.pdf.

Erikson, K. (2000). All children are ready to learn: an emergent vs. readiness perspective in early literacy assessment. *Seminars in Speech and Language*, 21, 193-203.

Erickson, K., Koppenhaver, D., & Yoder, D. (2002). *Waves of words: Augmented communicators read and write (vol. 3).* Toronto: International Society for Augmentative and Alternative Communication.

Fein, S. (1993). *First drawings: Genesis of visual thinking*. Pleasant Hill, CA: Exelrod Press.

Fielding, L., Wison, P., & Anderson, R. (1986). A new focus on free reading: The role of trade books in reading instruction. In T. Raphael (Ed.), *The contexts of school-based literacy*. (pp. 149-160). New York: Random House.

Flavell, J., Miller, P., & Miller, S. (2002). *Cognitive Development (4th Ed)*. New Jersey: Prentice Hall.

Flower, L., & Hayes, J. (1981). *A cognitive process theory of writing.* College Composition, 32, 365-387.

Foley, B. (1993). The development of literacy skills in individuals with severe congenital speech and motor impairments. *Topics in Language Disorders*, 13, 16-32.

Foley,B., & Pollatsek, A. (1999). Phonological processing and reading abilities in adolescents and adults with severe congenital speech impairments. *Augmentative and Alternative Communication,* 15, 156-174.

Foley, B., & Staples, A. (2003). Developing augmentative and alternative communication (AAC) and literacy interventions for adults with autism in a supported employment setting. *Topics in Language Disorder*, 23, 325 – 343.

Galda, L., Cullinan, B., & Strickland, D. (1993). *Language, literacy and the child*. Fort Worth, TX: Harcourt Brace Jovanovich College Press.

Gerbers, J. (1995). *Books are meant for talking, too, revised & expanded*. Tucson, AZ: Communication Skill Builders.

Good, T. & Brophy, J. (1995). <u>*Looking in classrooms* (6th ed)</u>. New York: Harper Collins.

Goodman, K. (1993). *Phonics phacts*. Portsmouth, NH: Heineman.

Goodman, K. (1986). *What's whole about whole language?* Portsmouth, NH: Heinemann.

Goossens', C., Crain, S., & Elder, P. (1992). *Engineering the classroom for interactive symbolic communication: An emphasis on the developmental period, 18 months to 5 years*. Birmingham, AL: Southeast Augmentative Communication Publications.

Gopnik, A., & Meltzoff, A. (1993). Words and thoughts in infancy: The specificity hypothesis and categorization and naming. In C. Rovee-Collier & L. Lipsitt (Eds.) *Advances in infancy research*. New Jersey: Ablex

Goswami, U., & Bryant, P. (1990). *Phonological skills and learning to read*. London: Lawrence Erlbaum Associates.

Gough, P.B. (1972). One second of reading. *Visible Language*, 6, 4, 291–320.

Gough, P.B., Larson, K. C., & Yopp, H. (2000). *The structure of phonemic awareness*. Retrieved on April 27, 2007 from http://www.psy.utexas.edu/psy/klarson/recife.html.

Grove, N., Dockerell, J., & Woll, B. (1996). The two-word stage in manual signs: Language development in signers with intellectual disability. In S. von Tetzchner & M. Jensen (Eds.), *Augmentative and alternative communication: European perspectives* (pp. 101 – 118). London: Whurr Publishers.

Gruber, H., & Vaneche, J. (1977). *The essential piaget*. New York: Basic Books.

Huer, M. (1995). *The non-speech test.* Wauconda, IL: Don Johnston, Inc.

Iacono, T., (2004). Accessible reading intervention: A work in progress. *Augmentative and Alternative Communication*, 20 (3), 179–190.

Iacono, T., & Cupples, L. (2004). Assessment of phonemic awareness and word reading skills in adults with complex communication needs. *Journal of Speech-Language Hearing Research*, 47, 437–449.

Iacono, T., Baladin, S., & Cupples, L. (2001). Focus group discussions of literacy assessment and world wide web-based reading intervention. *Augmentative and Alternative Communication*, 17, 27-36.

Iaconon, T., Cupples, L., Baladin, S., & Cassidy, S. (1999). *Reading skills assessment for web access.* Paper presented at the Australian Rehabilitation and Technology Association, Sydney.

Juel, C. (1988). Learning to read and write: a longitudinal study fifty-four children from first through fourth grade. *Journal of Educational Psychology*, 8, 437-447.

Karlan, G. (1990). Manual communication with those who can hear. In H. Bornstein (Ed.). *Manual Communication: Implications for Education* (pp. 151-185). Washington D.C.: Gallaudet College.

King-DeBaun, P. (1993). *Using stories for beginning communication and language learning*. A paper presented at Closing the Gap Conference, Minneapolis, MN.

Koppenhaver, D. (2000). Literacy in AAC: What should be written on the envelope we push? *Augmentative and Alternative Communication*, 16, 267-277.

Koppenhaver, D., Coleman, P., Kalman, S., & Yoder, D. (1991). The implications of emergent literacy research for children with development disabilities. *American Journal of Speech Language Pathology*, 1 (1), 38-44.

Koppenhaver, D., Evans, D., & Yoder, D. (1991). Childhood reading and writing experiences of literate adults with severe speech and motor impairments. *Augmentative and Alternative Communication*, 7, 20-33.

Koppenhaver, D., Pierce, P., Steelman, J., & Yoder, D. (1995). Contexts of early literacy intervention for children with developmental disabilities. In Fey, M., Windsor, J., & Warren, S. (Eds.). *Language Intervention: Preschool through the elementary years* (pp. 214-2740). Baltimore: Paul H. Brooks.

Koppenhaver, D., Spadorcia, S., & Harrison, M. (1998). *Improving reading comprehension skills for children with disabilities: A review of research.* Report for Office of Special Education Programs, U.S. Department of Education.

Koppenhaver, D., & Yoder, D. (1993). Classroom literacy instruction for children with severe speech and physical impairments (SSPI): What is and what might be. *Topics in Language Disorders.* 13(2) 1-15.

Korsten, J., Dunn, M., Foss, T., & Franke, M. (2006). *Every Move Counts*. Austin, TX: PRO-ED.

Light, J. (1989). Toward a definition of communicative competence for individuals using augmentative and alternative systems. *Augmentative and Alternative Communication*, 5, 137-144.

Light, J., & Binger, C. (1998). *Building communicative competence with individuals who use augmentative and alternative communication.* Baltimore: Paul H. Brookes.

Light, J., Binger, C., & Kelford-Smith, A. (1994). The story reading interactions of preschoolers who use augmentative and alternative communication systems and their nondisabled peers. *Augmentative and Alternative Communication,* 9, 10-25.

Light, J., & Kelford Smith, A. (1993). Home literacy experience of preschoolers who use AAC systems and of their nondisabled peers. *Augmentative and Alternative Communication,* 9, 10-25.

Lundberg, I. (1988). Preschool prevention of reading failure: Does training in phonological awareness work? In Marsland & Marsland, Eds. (1988). *Preschool Prevention of Reading Failure,* Parkton, MD: York Press, pp 163-176.

Lundberg, I., Frost, J., & Peterson, O. (1988). Effects of extensive program for stimulating phonological awareness in preschool children. *Reading Research Quarterly*, 23, 263-284.

Maehr, J. (1991). *Language and literacy*. Ypsilanti, MI: The High/Scope Press.

Mann. V. (1984). Longitudanal prediction and prevention of reading difficulty. *Annals of Dyslexia*. 34, 117-137.

Marvin, C., & Mirenda, P. (1993). Home literacy experiences of preschoolers enrolled in head start and special education programs. *Journal of Early Intervention*, 17, 351-367.

Mayer Johnson Company (2004) Picture Communication Symbols (Version 6.0) [Computer Software]. Solana Beach, CA: author.

Mayer-Johnson Co. (2006). Speaking Dynamically Pro (Version 6.0) [Computer Software]. Solana Beach, CA: Author

McNaughton, S. (1993). Graphic representational systems and literacy learning. *Topics in Language Disorders*, 13 (2), 58-75.

Microsoft Office Powerpoint (2003) [Computer Software]. Redmond, WA: Microsoft Corporation.

Mike, D. G. (1995). Literacy and cerebral palsy: Factors influencing literacy learning in a self-contained setting. *Journal of Reading Behavior*, 27, 4, 627 – 642.

Morais, J., Crary, L., Alegria, J., & Bertelson, P. (1979). Does awareness of speech as a sequence of phones arise spontaneously? *Cognition*, 7, 323 – 331.

Musselwhite, C., & King-DeBaun, P., (1997). *Emerging literacy success: Merging technology and whole language for students with disabilities*. Park City, UT: Creative Communicating.

Musselwhite, C., & St. Louis, K. (1988). *Communication programming for persons with severe handicaps: Vocal and augmentative strategies*. Austin, TX: Pro-Ed.

Inman, N. (2004). Word Power [Computer Software]. Wooster, OH: Prentke Romich Company.

Nelson, K. (1985). *Making sense: The development of meaning in early childhood*. New York: Academic Press.

Nelson, K. (1996). *Language in cognitive development: The emergence of the mediated mind*. New York: Cambridge University Press.

Nelson, N. (1992). Performance is the prize: Language competency and performance among aac users. *Augmentative and Alternative Communication.* 8, 3-18.

Nettleton, S. & Hoffman, Paul R. (2005). "*Phonic Faces vs. Animated Literacy Alphabets in Preschool Phonological Intervention*." Presentation at the American Speech and Hearing Association Convention. Philadephia, PA. November

Norris, J.A. (1998). I could read if I just had a little help: Facilitating reading in whole language contexts. In C. Weaver (Ed.), *Practicing what we know: Informed reading instruction* (pp. 513–553). Urbana, IL: NCTE Press.

Norris, J.A. (2001). *Phonic faces cards*. Baton Rouge, LA: Elementory.

Norris, J.A. (2001). *Phonic faces storybooks*. Baton Rouge, LA: Elementory.

Norris, J., & Hoffman, P. (2002). Phonemic awareness: A complex developmental process. *Topics In Language Disorders*, 22, 14–46.

O'Keefe, B., & Dattilo, J. (1992). teaching the response-recode form to adults with mental retardation using aac systems. *Augmentative and Alternative Communication*, 8, 224-233.

Pemberton, A. Alphabet Stories (2004). Retrieved on April 27, 2006 from http://www.educationalsynthesis.org/books/Alphabet.

Perfetti, C.A., Beck, I., Bell, L., & Hughes, C. (1987). Phonemic knowledge and learning to read are reciprocal: A longitudinal study of first grade children. *Merrill-Palmer Quarterly*, 33, 283–319.

Piaget, J. (1952). *The Origins of Intelligence in Children*. New York: International University Press.

Pierce, P., & McWilliams, P. (1993). Emerging literacy and children with severe speech and physical impairments (SSPI): Issues and possible intervention strategies. *Topics in Language Disorders,* 13, (2), 47-57.

Pierce, C. (1971). Collected Writings (8 Vols.). C. Hartshorne, P. Weiss & A. Burks (Eds.). Cambridge, MA: Harvard University Press

Prentke Romich Company (2005). Spring Board Communication Device. Wooster, OH: Author.

Prentke Romich Company Inc. (1995). UNITY. [Computer Software]. Wooster, OH: Author.

Prentke Romich Company Inc. (2000). Vanguard Communication Device. Wooster, OH: Author.

Prentke Romich Company Inc. (2003). Vantage Communication Device. Wooster, OH: Author.

Redmond, S., & Johnston, S. (2001). Evaluating the Morphological Competency of Children with Severe Speech and Physical Impairments. *Journal of Speech, Language and Hearing Research,* 44, 1362-1375.

Robertson, C., & Salter, W. (1997). *Test of Phonological Awareness*. East Moline, IL: Linguisystems, Inc.

Samuels, S. (1985). Automaticity and Repeated Reading. In J. Osborn, P. Wiolson, R. Anderson, Eds. *Reading education: Foundations for a Literate America*. (pp. 215 – 230). Lexington, MA: Lexington Books.

Saussure de, F. (1955) *Cours de Linguistique Générale* Paris: Payot

Sawyer, D. (1987). *Test of awareness of language segments (TALS)*. Rockville, MD: Aspen Publishers.

Scarborough, H., & Dobrich, W. (1994). On the efficacy of reading to preschoolers. *Developmental Review*, 14, 245 –302.

Smith, M. (1996). The Medium or the Message: A Study of Speaking Children using Communication Boards. In S. von Tetzchner & M. Jensen (Eds.), *Augmentative and Alternative Communication*, 8, 57-66.

Smith, F. (1985). *Reading without nonsense (2nd ed.)*. New York: Teachers College Press.

Snow, C., Burns, S., & Griffin, P. (Eds.). (1998). *Preventing reading difficulties in young children*. Washington DC: National Academy Press.

Snow, C., & Nino, A. (1986). The contracts of literacy: What children learn from learning to read books. In W. Teale & E. Sulzby (Eds.) *Emergent literacy: Writing and reading*, 116-138. Norwood, NJ: Ablex.

Stanovich, K. (1991). Discrepancy definition of reading disability: Has intelligence led us astray? *Reading Research Quartlerly*, 19, 278-303.

Stanovich, K., Cunningham, A., & Cramer, B. (1984). Assessing phonological awareness in kindergarten children: Issues of task comparability. *Journal of Experimental Child Psychology*, 38, 175–190.

Stanovich, K., & Siegel, L. (1994). Phenotypic performance profiles of children with reading disabilities: A regression based test of the phonological-core variable-difference model. *Journal of Educational Psychology*, 86, 24 – 53.

Stahl, S. (1992). Saying the 'p' word: nine guidelines for exemplary phonics instruction. *The Reading Teacher*, 44, 428-430.

Strickland, D., & Taylor, D. (1989). Family storybook reading: Implications for children, families and curriculum. In W. Teale & Sulzby (Eds.) *Emergent Literacy: Young Children Learn to Read and Write*. pp. 63-79. Norwood, NJ: Ablex.

Strum, J., Spadorcia, S., Cunningham, J. Cali, K. Staples, A., Erickson, E., Yoder, D., & Koppenhaver, D. (2006). What happens to reading between first and third grade? Implications for students who use AAC. *Augmentative and Alternative Communication*, 22 (1), pp. 21 – 36.

Sutton, A., & Gallagher, T. (1993). Verb class distinctions and AAC language-encoding limitations. *Journal of Speech and Hearing Research*, 36, 1216-1226.

Sutton, A. (1996). Language theory and intervention practice. In E. Björck-Åkesson & P. Lindsay (Eds.), *Communication Naturally: Theoretical and methodological issues in augmentative and alternative communication*, pp. 33-47. Proceedings of the Fourth ISAAC Research Symposium. Västerås, Sweden: Mälardalen University Press.

Teale, W. (1982). Toward a theory of how children learn to read and write naturally. *Language Arts*, 59, 902-911.

Teale, W., & Sulzby, E. (1986). *Emergent literacy: Writing and reading*. Norwood, NJ: Ablex.

Tractenberg, P. (1990). Using children's literature to enhance phonics instruction. *The Reading Teacher,* 43, 648-653.

United States Department of Education (2001). The No Child Left Behind Act of 2001(NCLB) PL 70-110. Retrieved on April 28, 2007 from http://www.ed.gov/policy/elsec/leg/esea02/107-110.pdf.

Vandervelden, M., & Siegel, L. (1995). Phonoloical recoding and phoneme awareness in early literacy: A developmental approach. *Reading Research Quarterly*, 30, 134-159.

Vandervelden, M., & Siegel, L. (1999). Phonological processing and literacy in AAC users and students with motor speech impairments. *Augmentative and Alternative Communication*, 15, 191-212.

Vandervelden, M., & Siegel, L. (2001). Phonological processing in written word learning: assessment for children who use AAC. *Augmentative and Alternative Communication,* 17, 37-51.

Van Balkom, H., & Welle Donker-Gimbrere, M. (1996). A psycholinguistic approach to graphic language use. In S. von Tetzchner & M. Jensen (Eds.), *Augmentative and Alternative Communication: European Perspectives* (pp. 153-170). London: Whurr Publishers.

van Kleeck, A. (1998). Preliteracy domains and stages: Laying the foundations for beginning reading. *Journal of Children's Communication Development*, 1, 33–51.

Vygotsky, L. (1978). *Mind in society: The development of psychological processes*. Cambridge, MA: Harvard University Press

Wagner, R., & Torgeson, J. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin,* 101, 192 – 212.

Weaver, C. (1994). *Reading process and practice from socio-psycholinguistics to whole language*. Portsmouth: Heinemann.

Yoder, D., Erikson, K., & Koppenhaver, D. (1997). *A literacy bill of rights*. Chapel Hill, NC: University of North Carolina at Chapel Hill, Center for Literacy and Disability Studies.

Yopp, H. (1995). A test for assessing phonemic awareness in young children. *The Reading Teacher*, 49, 20-29.

Yopp, H.K. (1988). The validity and reliability of phonemic awareness tests. *Reading Research Quarterly*, 23, 159–177.

APPENDIX A: ADAPTATIONS TO PRE AND POST TEST ITEMS

Adaptations to the Informal Reading Inventory – 8th edition (Burns & Roe, 2006)

This test was used to evaluate the students' pre and post reading levels. Three subtests (word recognition, silent comprehension and listening comprehension) were used during the study. Since all subtests required an oral response, they were adapted for a nonverbal response as follows:

a. Word Recognition: Twenty words from the pre-primer graded word lists were divided into groups of 4, enlarged, and placed on an eye gaze frame. The examiner randomly named a word and the subject used eye gaze or pointing (if capable) to identify the corresponding word. Four of the 20 words occurred more than once in the assessment. These words were used to assess reliability of responses.

b. Oral Reading Comprehension: The subjects were presented with the appropriate reading passage from Form A of the booklet (no modifications). The subjects were asked to read the passage silently or verbally if they choose (intelligible responses are not expected). The subjects then were presented with the questions from the manual, modified for response elicitation. That is, while the manual calls for verbal responses, the questions were redesigned to a multiple-choice format, with one correct response and 3 foils per question. The four choices were mounted on an eye gaze frame, and read to the subjects while they followed along. The subjects were then asked to identify answers to the questions using pointing or eye gaze.

c. Listening Comprehension: The subjects were presented with the appropriate reading passage from Form B of the booklet (no modifications). The passage was read orally to the subjects, and the multiple-choice questions presented using the same procedures as for the Oral

d. Reading Comprehension task. This measure helped to differentiate between incorrect responses due to reading failure versus a language comprehension deficit.

<p style="text-align:center">Adaptations to The Phonological Awareness Test</p>

Phonological awareness skills of the students were assessed using The Phonological Awareness Test. Seven subtests were used during pre and post test procedures. Since all three subtests required a verbal response the following adaptations were made to the subtests in order to compensate for the nonverbal response of the students:

a. Rhyming, Discrimination: The test requires a yes/no response to indicate whether a pair of given words rhyme. Subjects were offered a yes/no choice on an eye gaze frame. The subjects were required to eye gaze or point to their answer.

   Rhyming, Production: The test requires the subjects to give the correct rhyming word. The correct written word or picture and 3 foils were offered on an eye gaze frame. Subjects were required to eye gaze or point to their answer.

b. Segmentation: The test requires the subjects to divide sentences into words, words into syllables and words into phonemes or sounds. Correct answer or a number corresponding to the syllables and 3 foils were presented on an eye gaze frame. The subjects were required to eye gaze or point to respond.

c. Isolation: The test requires subjects to identify a phoneme by positions in a word (initial, final and medial). Initial, medial and final positions of the phoneme were represented as an engine, car and caboose of an engine. These were presented to the subjects on an eye gaze board and the subjects asked to eye gaze or point to respond.

d. Substitution: This test requires the subjects to isolate a sound in a word, and then change it to another sound to form a new word. The picture of the new word formed was presented with 3 other pictures of foils and the subjects were required to point or eye gaze to respond.

e. Deletion (compounds and syllables): This task measures the subject's ability to say a word and then say it again, deleting one root word or syllable.

    Deletion (phonemes): In this test, the subject says a word and then says it again, deleting one of its phonemes or sounds. Picture of the correct word formed was presented together with 3 other foils on a choice board and the subjects were required to make a choice using eye gaze or pointing.

f. Blending subtest: assesses the subject's ability to blend units of sound together to form words. The picture of the correct word formed was presented with the 3 other pictures of foils and the subjects were required to point or eye gaze to respond.

g. Graphemes subtest: assesses the subject's knowledge of sound/symbol correspondence. Only the sound to letter knowledge was assessed in this subtest. The subjects were presented with a sound, and were required to respond by selecting the corresponding letter from a choice of three (one correct letter and two foils). The choices were presented on the eye gaze or choice board. The subjects were requested to eye gaze or point to respond.
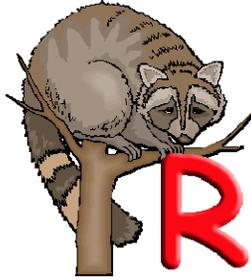
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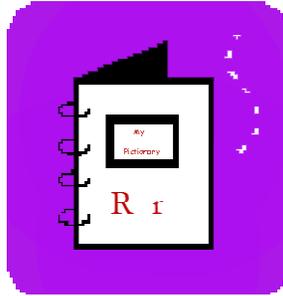
Sidney Finds R Things

By Anne Pemberton

It was time for Alphabet Class.

Meher asked,

"What letter we are learning this week?"

"The Letter **R**," answered Sidney.

"Good girl," said Meher.

"So, get your Pictionary,

and let's go find some **R** things!"

Meher and Sidney went to the zoo.
They looked at animals that live near rivers.
They saw a black-masked **raccoon**.
Meher pointed to the **raccoon**.
Sidney said, "A **raccoon** is an **R** thing,"
"Yes," said Meher,
"you can put a **raccoon** in your Pictionary."

Sidney and Meher were done with their field trip.
Meher asked Sidney,
"Did you have fun today?"
"Yes! Yes! Yes!" said Sidney.
"It was fun finding **R** things!"
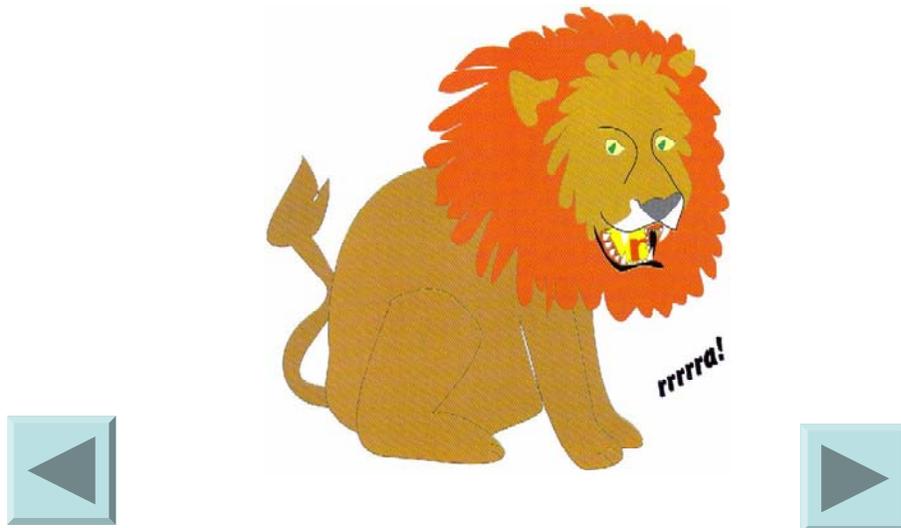
By Janet Norris

I feel like roaring said Arlene

And she transformed into a lion

rrrrra!

"When I want to roar and growl again."

"All I need is the letter "r"," snarled Arlene

VITA

Meher Banajee who resides in Kenner, came to the United States from India in 1984. She obtained her Master of Science degree in Speech Pathology and Audiology from All India Institute of Speech and Hearing, University of Mysore, India, in 1977, and her Bachelor of Science degree in Speech Pathology and Audiology from Topiwala National Medical College, University of Bombay, India, in 1975. She currently holds a Certificate of Clinical Competence from the American Speech-Language-Hearing Association, Rockville, Maryland, in Speech Pathology and is licensed by Louisiana Board of Examiners in Speech Pathology and Audiology to practice in Louisiana.

Meher is currently working as an Assistant Professor at the Louisiana State University Health Sciences Center, Communication Disorders Department. Her current responsibilities Include teaching, research and service to clients and the school. She has been adjunct faculty at the same facility from March 2005. She teaches classes in early intervention, articulation and phonology and augmentative and alternative communication. She has served as an assistive technology coordinator for Region 1 From March 2004 to September 2006 and was responsible for setting up an Assistive Technology (AT) Lab, developing policies and procedures for AT, and training AT teams in the 5 school districts in Region 1. Before which she worked (from July 1995 to March 2004) as an Assistant professor with the Human Development Center (at LSUHSC) in their Infant and Toddler program where her responsibilities included: providing early intervention services in an inclusive classroom setting and within their natural environment (home or daycare setting).

Meher has also worked as the Augmentative and Alternative Communication Coordinator at Children's Hospital in New Orleans and as a consultant for Prentke Romich Company (for 5 years). She managed the communication disorders department at Metropolitan Development Center (from 1985-1988) and supervised four other speech language pathologists.

After Hurricane Katrina, she was approached by USSAAC (United States Society for Augmentative and Alternative Communication) to serve as a coordinator for their Gulf States Hurricane Relief Plan. She still coordinates this effort. Her responsibilities include: coordinating and matching donations of devices, accessories, services and employment offers to users whose devices were lost in the storm.

Meher consults with several different school districts which include the Orleans Parish Public School District, Recovery School District, and Plaquemines Parish School District. She is a member of the Assistive technology task force member and served on the advisory board for Louisiana Assistive Technology Network (LATAN) until November 2006.

Meher has published several different articles in the past. Examples of these include the following:

a.   Banajee, M., Baker, B., & Anderson, A. (2003). Quantitative data on young child language use: Implications for AAC. Closing the Gap, 22,1,10-13,28.

b.   Banajee, M., DiCarlo, C., & Stricklin, S. (2003). Core vocabulary determination in toddlers. AAC, 19, 67-73.

c.   DiCarlo, C., Stricklin, S., Banajee, M., & Reid, D. (2001). Effects of manual signing on Communicative verbalizations by Toddlers with and without disabilities in Inclusive Classrooms. JASH 26, 120-126.

d.   DiCarlo, C., & Banajee, M. (2000). Increasing initiations through the use of augmentative communication devices. Journal of Early Intervention, 23, 119-198.

e.   DiCarlo, C., & Banajee, M. (2000, March). Integrating augmentative and alternative communication within an early intervention program. Young Exceptional Children, 3, 18-26.

Meher's various national, state and regional presentations include:

a.   Banajee, M. & Norris, J. (2004, November). Using Technology to Facilitate Expository Writing Skills. Poster presented at ASHA National Convention, Philadelphia, PA.

b.   Banajee, M. & Baker, B. (2004, June). A Principled Approach to selecting the first 75 words to teach in an AAC system. RESNA convention, Orlando, FL.

c.   Banajee, M. (2003, November). Core Vocabulary Determination in Toddlers. Poster presented at ASHA National convention, Chicago, IL.

d.   Banajee, M., Baker, B., & Anderson, A. (2003, March). Language development principles to develop and teach vocabulary for AAC. United States Society for Augmentative and Alternative Communication Conference, Los Angeles, CA.

e.   Banajee, M. & Baker, B. (2002, October). Early language and its building blocks. Southeast Augmentative and Alternative Communication Conference, Birmingham, AL.

f.   Banajee, M. (2002, November). Camping with AAC. Poster presented at ASHA National Convention, Atlanta, GA.

g.   Banajee, M. (2006, June). Selection of core and fringe vocabulary in for communication devices. Workshop presented at Louisiana Speech and Hearing Association, Baton Rouge, LA

h.   Banajee, M. (2006, September). Selection of core and fringe vocabulary in for communication devices. Workshop presented at Speech Pathologist and Audiologist in   Louisiana Schools, Baton Rouge, LA