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THE EFFECTS OF SYMBOL ORGANIZATION STRATEGY ON SYNTACTICAL LANGUAGE PRODUCTION IN FIRST GRADE CHILDREN

An Abstract of a Thesis

Submitted

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

Daniel Thomas Baier

University of Northern Iowa

December 2000

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Augmentative and alternative communication (AAC) is the process in which a person's disordered speech is augmented or assisted with communication technology. This study investigated the effects of vocabulary organization using branching capabilities of a high technology device on sentence construction. Information about vocabulary organization strategies might be important for addressing the language and literacy deficits that were noted in previous research with AAC users. The study attempted to investigate whether or not vocabulary organization in a grammatical sequence across one page or multiple pages would improve non-AAC users abilities to retell a story using AAC technology. Six students participated in the study. Two students aided in supplying the vocabulary for the study, while the remaining four participated in the experimental phase of the study. The experimental phase included the use of grammar organized into categories across a single page or a multiple page sequence. Each user participated in a sentence imitation, computer generated story task (CGST), and an oral story task. Preliminary findings suggested that organizing vocabulary by grammatical structure utilizing a multiple screen design was associated with greater accuracy for a sentence imitation task. Users of the multiple screen design were able to attend to symbols and form a pattern for scanning that was more effective for sentence imitation and sentence construction. Finally sentences generated with each screen design did differ from orally generated sentences in the overall total words, words/sentence ratio, total time, number of grammatical categories used and types of grammatical categories used.

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This study by: Daniel Thomas Baier

Entitled: The Effects of Symbol Organization Strategy on Syntactical Language Production In First Grade Children

has been approved as meeting the thesis requirement of the

Degree of Master of Arts

8/1/00 — Dr. Lauren Nelson, Chair, Thesis Committee

Date

8/1/00 — Dr. Clifford Highnam, Thesis Committee Member

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9/8/2000 — Dr. John W. Somervill, Dean, Graduate College

Date

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CHAPTER 1

REVIEW OF LITERATURE

Augmentative and alternative communication (AAC) is described as the process in which a person's disordered speech is augmented or assisted with communication technology (Beukelman & Mirenda, 1998; Lloyd, Fuller, & Arvidson, 1997). The American Speech-Language-Hearing Association (ASHA) defined AAC as "an area of clinical practice that attempts to compensate (either temporarily or permanently) for the impairment and disability patterns of individuals with severe expressive communication disorders (i.e., the severely speech-language and writing impaired)" (1989, p. 107). There are three main perspectives outlined in this definition; the AAC user, AAC technology and the AAC process.

The users of AAC come from all aspects of society. They include all social, economic, and ethnic backgrounds and the single characteristic that binds them is their dependence on adaptive assistance (Beukelman & Mirenda, 1998). AAC users for a variety of reasons are not able to efficiently communicate verbally or are physically unable to write. This expressive communication impairment can be the result of a variety of congenital or acquired conditions. Some of the most common include cerebral palsy, mental retardation, autism, traumatic brain injury, stroke, multiple sclerosis and developmental apraxia of speech. It is estimated that "8-12 individuals per 1,000 in the general population experience severe communication impairments that require AAC" (Beukelman & Mirenda, 1998, p. 4). The degree of impairment may also be amplified by other physical and mental deficiencies that make assisting communication a complex process.

Because augmentative communication specialists were faced with a variety of communicative, physical and mental impairments, a demand for new and efficient

alternatives to spoken and written communication were created. Because of this demand the application of technology to the field became referenced as "assistive technology" (Quist & Lloyd, 1997, p. 107). Assistive technology can include computer-driven artificial limbs, cochlear implants, Braille, image magnifiers, power wheelchairs, adapted computers, and more. "Any one item, piece of equipment, or product, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities" (Quist & Lloyd, 1997, p. 107) became known as an assistive technology device. In AAC "technology has taken on a major role in enabling individuals with little or no functional speech to communicate" (Quist & Lloyd, 1997, p. 107). Technology created a large range of methods and devices to assist the communication of AAC users.

The technology in AAC is often divided into two categories low technology and high technology (Quist & Lloyd, 1997). Low technology AAC devices do not have printed or speech output and no vocabulary storage or programming capabilities (Quist & Lloyd, 1997). Examples of low technology include communication boards, switch operated toys, and head pointers. Devices defined as high technology include computerized systems operated through specialized software which allow for speech output, vocabulary storage, and vocabulary programming (Quist & Lloyd, 1997). The generalized categories do leave room for confusion, but each individual's requirements dictate the types of technology needed for communication.

This study focused on the AAC process related to the use of high technology devices, specifically those with dynamic displays. Dynamic display capability is one aspect of high technology devices that has improved AAC communication potential. This display system allows vocabulary storage across numerous pages or screens and programmable screen buttons allowing independent branching of pages. Burkhart (1994) explained

"page" (p. 3) referred to a single computer screen or display that contained symbols. Whether or not the device is a low technology or a high technology voice output device, the typical page is a series of pictures contained within squares or buttons which are arranged in rows and columns. The term "button" (Burkhart, 1994, p. 3) described the graphic symbol representing vocabulary or an electronic task on the screen. When a button was selected by direct (e.g., touch) or indirect selection (e.g., scanning, mouse) the task of the button (e.g., speak programmed message, turn page) was carried out. Changing pages followed a programmable sequence which was referred to as "branching" (Burkhart, 1994, p. 3). The pages are branched together by electronically linking them. A good example of dynamic display is a cash machine. When you press the desired option (e.g., checking, savings) a new set of options appears. Devices for AAC that utilize branching and multiple page displays are considered dynamic because the display screen automatically changes in response to user input.

Assistive Technology and Communicative Competence

Dynamic displays and other technology lead to a new perspective on the process of communication, the "assistive technology perspective" (Lloyd et al., 1997, p.10). An AAC user is dependent upon the use of assistive technology and the proper use of the technology partially determines the AAC user's ability to learn to communicate effectively. Communicating is a complex process. Lloyd et al. (1997) presented one model of communication that has been applied to the field of AAC. It is recognized that this is one model of communication and there are other models based on the different theories of language acquisition (e.g., behaviorist, sociolinguistic, pyscholinguistic). According to Lloyd et al., communication is "a sender and a receiver both of whom bring to the process experience and physical, psychological, social, cognitive, and linguistic abilities" (Lloyd et al., 1997, p. 6). To exchange information effectively one must be a competent

communicator. Light (1989) defined four competencies essential for effective communication with assistive technology. These are linguistic competence, operational competence, social competence, and strategic competence. In presenting this model, Light recognized that "communication competence is greater than each of the components alone" (Light, 1989, p. 141). Light (1989) exemplified it best by saying:

> If individuals have developed adequate linguistic skills in the native language of their community and in their AAC systems with sufficient speed and accuracy, but they have not developed the necessary sociolinguistic and sociorelational skills to initiate interactions and develop interpersonal relations, they may find themselves severely restricted in their opportunities for communication and in their access of communication partners. (p. 141)

Linguistic competence refers to an individual's knowledge of the language. It refers to competence in the six domains of language (i.e., speech acts, pragmatics, phonology, semantics, morphology, and syntax). Linguistic competence also includes an ability to think about the language being used. The ability to think about language independent of comprehension or production of the language is known as metalinguistic ability (Nippold, 1998; Owens, 1991).

Operational competence is unique to the AAC process. It encompasses an individual's understanding of how to manage specific technology. It includes the ability to turn a device on, turn the volume up or down, or operate a selection method.

Social competence refers to a person's ability to understand and follow the sociolinguistic and sociorelational aspects of a language. Light (1989) summarized sociolinguistic skills to include an understanding of discourse strategies (e.g., initiating, maintaining, terminating, turn taking, cohesion of conversation), interaction functions (e.g., expression of needs and wants, social closeness, information transfer), and specific communication functions (e.g., requests for information, protest, self expression). These

sociolinguistic skills are dependent upon partner, setting and task demands and are typically evaluated in terms of their appropriateness and effectiveness. Sociorelational skills deal heavily with the AAC users view of him or herself as a communicator. An AAC user's self image, interest in communication, and responsiveness to communication can determine the relative competence of the communicator as well. Sociolinguistic and sociorelational skills can affect an individual's number and length of communication interactions.

Strategic competence includes the techniques used to increase the efficiency of communication and to re-establish communication when a breakdown occurs in understanding. Information requesting, listener awareness, repetition, and clarification exemplify strategies used by a competent communicator. This competence illustrates the dynamic nature of communication.

Understanding the complexity of communication competencies enabled AAC specialists to specify the central goal of AAC.

> Provide individuals with the opportunity and capability 1) to communicate messages so that they can interact in conversations; 2) to participate at home, in school, at work, and during recreational activities; 3) to learn their native language; 4) to establish and maintain their social roles (e.g., friend, student, spouse); 5) to meet their personal needs. (Beukelman & Mirenda, 1998, p. 13)

The field of AAC came to be defined as a means for helping individuals who cannot speak, communicate through the use of technology. In aiding AAC users, the central goal was to provide the opportunities and capabilities to be a competent communicator. Under this definition a unique process was formed, the process of message selection. Selecting the proper word or forming a message for most communicators can be described as a very straight forward process. A young child with normal speech has the ability to generate spoken output for a majority of words within

their mental lexicon. This enables the child to create an infinite number of messages. The severe speech impairments (SSI) of the AAC user complicate the message generation and selection process. The child with SSI lacks the ability to independently generate a large number of messages. Rather, the child is dependent upon others to anticipate their lexicon needs and provide AAC technology to expand beyond the impairments of SSI. The limits on independent message formulation created a need for an outside facilitator to preselect vocabulary, introduce technology that would enable communication, and introduce vocabulary selection techniques.

Vocabulary for AAC

The AAC user is dependent on the team of AAC facilitators for vocabulary and instruction. In selection of vocabulary, the AAC team considers the overall communication capability of the AAC user. Beukelman and Mirenda (1998) discussed three types of users: "1) those who are preliterate, such as young children who have not yet learned to write or read; 2) those who are non-literate, such as individuals who are not able to learn to read or write and people who have lost these abilities because or their impairments; and 3) those who are literate" (p. 28). Although these categories are useful for the discussion of vocabulary selection, it is recognized that literacy learning is a gradual process. The literacy learning process is understood to include a variety of literacy experiences such as reading product labels, distinguishing art from text, and the ability to construct and tell a story (Harste, Woodward, & Burke, 1984). The preliterate AAC user according to Beukelman and Mirenda's (1998) definition would be an individual who is unable to independently spell words to generate messages. However, these individuals could possess the forms of literacy learning that occur prior to formal schooling. Vocabulary access is a critical issue for children who do not have a generative

spelling ability, because these children are not able to read or write in a manner that allows for efficient use of written messages to communicate (Beukelman & Mirenda, 1998).

There are two types of vocabulary to be considered for an AAC user without generative spelling abilities. The first type of vocabulary considered is coverage vocabulary (Arvidson & Lloyd, 1997; Beukelman & Mirenda, 1998). Coverage vocabulary contains messages for basic everyday communication needs. These messages allow the user to inform caregivers about the need to use the bathroom or obtain a drink of water as well as maintain social interactions. Coverage vocabulary enables the AAC user to communicate about content that is experienced on a regular, nearly daily basis. The second type of vocabulary considered is developmental vocabulary (Arvidson & Lloyd, 1997; Beukelman & Mirenda, 1998). This vocabulary is provided to encourage language and vocabulary growth. The developmental vocabulary addresses new content or experiences. Both the symbol and its relationship to the content it represents must be taught. These two types of vocabulary together address current and anticipated future communication needs.

A variety of symbols are used to represent vocabulary for an AAC user. The relationship between vocabulary and symbols can best be explained by illustrating hand gestures such as waving goodbye or signs such as stop or child crossing. Symbols are one of the mediums through which an AAC user could communicate. The symbol is a referent to something else. In the case of vocabulary symbols a picture of a person running might represent the word go or a hand gesture that looks like someone holding a cup might represent "I need a drink". Symbols are divided into aided and unaided symbols (Beukelman & Mirenda, 1998; Lloyd, Fuller, Loncke, & Bos, 1997). Aided symbols require external assistance from a device for production. Real objects and black-and-white drawings are classified as examples of aided symbols. Aided symbols are divided

into tangible symbols (e.g., real objects, miniature objects) and representational symbols (e.g., photographs, line drawings). On the other hand, unaided symbols require no external device for production. Facial expressions, manual signs, and speech are classified as unaided symbols. In this study aided representational symbols were used, although it is acknowledged that the best approach is to use a combination of aided and unaided symbols for AAC intervention. Because aided and unaided symbols address the individual's communication needs in a different way, augmentative communication is approached as a multimodal process that utilizes aided and unaided symbols.

For the AAC user without generative spelling abilities, representational aided symbols are one of the favored mediums through which AAC facilitators provide access to communication. The preliterate AAC user can be taught the native language through the use of these representational aided symbols. The notion that the AAC user has both a coverage vocabulary and developmental vocabulary relates to the central goal of AAC facilitation, which was to establish a communication system that allows a user to communicate today and in the future (Beukelman & Mirenda, 1998). In order to accomplish this goal, an AAC facilitator is responsible for creating an AAC system that meets the immediate communication needs of the young child and also serves as a means for them to increase their linguistic competence.

Linguistic Competence in AAC Users

As noted previously, Beukelman and Mirenda (1998) suggested that linguistic competence encompasses skills in the six domains of language (i.e., speech acts, pragmatics, phonology, semantics, morphology, and syntax). To meet the future communication needs of a young child, the AAC system should facilitate development within all six language domains. To assure this is occurring, assessment of language development plays a role in AAC planning (Blischak, Loncke, & Waller, 1997; Galda,

Cullman, & Strickland, 1993). According to Beukelman and Mirenda, a language assessment should include comprehension of single-word vocabulary and syntactic or grammatical knowledge. The information must not be used in the traditional way to establish a developmental age, but rather to generate a profile of current capabilities. This profile will aid facilitators in selecting appropriate strategies and techniques to foster immediate communication and continued language learning.

Profiles of the language capabilities of many AAC users have revealed language learning difficulties. However, as discussed previously, language is composed of six domains; speech acts, pragmatics, phonology, semantics, morphology, and syntax. Beukelman and Mirenda (1998) summarize the language learning difficulties of AAC users under the constraints of these six domains. They identified varied language capabilities among AAC users. Although some AAC users had deficits in expressive and/or receptive language, others demonstrated high level language abilities, including independent lexicon selection, increased reading comprehension, and increased social conversation abilities, once written expression was mastered. For those who had language deficits, the problems varied in nature. It was found that AAC users, when interacting with others, tended to seldom initiate conversation, responded only when required to do so, and produced minimal informative messages (Calculator & Luchko, 1983; von Tetzchner & Martinsen, 1996). AAC users were at risk to have delays in phonological development in the absence of intervention. The reports have also outlined the semantic development difficulties AAC users have experienced. Several researchers have identified limited access to vocabulary, inability to independently select vocabulary, and inappropriate feedback as hindrances of semantic development (Smith, 1996; van Balkom & Welle Donker-Gimbrere, 1996; von Tetzchner & Martinsen, 1996).

Several studies have addressed use of grammatical morphemes and syntactical structures by AAC users. Sutton and Gallagher (1993) demonstrated AAC users have difficulty with grammatical morphemes especially verb tenses. Other researchers reported a predominance of one- or two-word messages, unusual word order, omission of frequently appearing words and limited complexity of syntactic structure (Basil & Soro-Camats, 1996; Smith, 1996; van Balkom & Welle Donker-Gimbrere, 1996; von Tetzchner & Martinsen, 1996) as characteristics of syntactical structure. Collectively, the studies reviewed by Beukelman and Mirenda (1998) suggested that AAC users were at risk for delays in the development of all six domains of language. The conclusion reached was "clearly strategies specifically aimed at language development need to be an integral part of every communication intervention" (Beukelman & Mirenda, 1998, p. 337).

Research which addresses issues associated with facilitation of language learning is critical to the development of AAC technology, strategies, and techniques. This is true both because future language needs are a basic goal of AAC intervention and because previous research has shown AAC users are at risk for delays in language development. The present study attempted to partially address the need for research on facilitation of language learning utilizing AAC devices by exploring two different ways to organize the child's vocabulary on an AAC system. The focus was on syntactic competence because the organizational strategies affect the way children access their vocabulary to construct sentences. Although syntax was the domain of focus of the present study, it is acknowledged that all domains are dependent upon one another.

Syntax refers to established rules for putting words into sentences. Differences previously identified in AAC users' sentences included a predominance of one- or two-word messages, unusual word order, omission of frequently appearing words, and limited complexity of syntactic structure (Basil & Soro-Camats, 1996; Smith, 1996; van

Balkom & Welle Donker-Gimbrere, 1996; von Tetzchner & Martinsen, 1996). Beukelman and Mirenda summarized work from Soto (1996) on three main conclusions regarding the syntactical difficulty experienced by AAC users.

> First, many AAC users show evidence of both receptive and expressive language impairments. Second, although this may not be obvious from the above, some AAC users do not show evidence of both impairments... Third,... the language difficulties experienced by many AAC users are undoubtedly influenced by the fact that their language-learning experiences are so very different from those of individuals who can speak. (1998, p. 337)

Specifically AAC users syntactic development is dominated by the following characteristics:

1. AAC users message production is marked with predominance of one or two word messages (Basil & Soro-Camats, 1996; Smith, 1996; van Balkom & Welle Donker-Gimbrere, 1996; von Tetzchner & Martinsen, 1996)

2. Word order deviations were noticed. AAC users constructed messages that deviated from usual word order in simple phrases and compound sentences. Typical examples were verb-subject-object (e.g., clean+girl+mommy desk) or subject-object-verb (e.g., boy+store+go; van Balkom & Welle Donker-Gimbrere, 1996).

3. Phrase construction was characterized by a "succession of nouns" (van Balkom & Welle Donker-Gimbrere, 1996, p. 165).

4. Sentences reflected limited use of auxiliary verbs and negations (van Balkom & Welle Donker-Gimbrere, 1996).

An AAC user's syntax can be summarized as limited in use of correct complex, grammatical sentences and frequent in use of simple, noun laden clauses. Collectively, the results of the studies indicate a deficit in linguistic competence. The presence of linguistic deficits among children who use AAC lead to an important question about the

development of literacy skills. Foley stated that "the level in competence in both receptive (listening, reading) and productive (speaking, writing) language processes that most nondisabled children seem to acquire quite naturally is an extremely difficult attainment in persons using AAC (1993, p. 17). Numerous researchers have discussed the differences and similarities of oral and written language (Catts, 1993; Clay, 1991; Foley, 1993; Harste et al., 1984; Kamhi & Catts, 1986; McNaughton, 1993; Pierce & McWilliam, 1993; Smith, 1994). A general conclusion reached was that linguistic competencies such as vocabulary, syntax, and phonology are important aspects of spoken communication and in turn have proven to be important aspects of literacy learning. In a non AAC users spoken language is the main mode of communication augmented by gestures, writing, and symbols. AAC users must rely on symbolic or written language as a primary mode for communication. Given the linguistic deficits in AAC users it seems important to consider literacy learning and ways to facilitate literacy learning to address the development of competent communication. Literacy will be broadly referred to as "the mastery of language, in both spoken (or augmented) and written forms, which enables an individual to use language fluently for a variety of purposes" (Foley, 1993, p. 17).

Literacy and AAC Users

Beukelman and Mirenda (1998) felt that young AAC users were at a disadvantage for literacy learning during the preschool years for a variety of reasons. "Individuals with severe speech and physical impairments (SSPIs) not only have motor impairments that limit their access to books and writing tools but may also have language and cognitive impairments that further complicate the literacy learning process" (Beukelman & Mirenda, 1998, p. 356). This is based on the accepted premise that there is a close relation between spoken language abilities and literacy learning (Clay, 1991; Foley, 1993; Harste et al., 1984). Research by Kamhi and Catts (1986) demonstrated that the earliest indications of

written language disorders are preschool language impairments. Catts (1993) noted that deficits in reading ability often are associated with deficits in oral language ability. Through follow-up studies of children with language impairments and examinations of language problems in children with reading disabilities, phonological awareness was identified as a predictor of reading outcome (Foley, 1993). Phonological awareness refers to a knowledge of the phonological structure of the language. Phonological awareness skills are acquired through an understanding of the division of linguistic units, "first words in sentences, then syllables in words, then phonemes in syllables (Foley, 1993, p. 19). Catts (1993) found that written word decoding in first grade children was best predicted by measures of phonological awareness and rapid automatized naming. However, reading comprehension was best predicted by expressive and receptive language measures (e.g., vocabulary, use of grammatical morphemes, syntactic comprehension). In view of the evidence of language deficits in AAC users and the correlation between language abilities and literacy, it becomes clear that AAC facilitators must consider language and literacy development when providing instruction and educational adaptations for AAC users.

AAC Instructional Techniques and Strategies

AAC research has sought to formulate solutions for the differences in language and literacy development detailed above. The research addressed many elements of augmentative communication interventions including symbols systems, teaching strategies, and organizational strategies. Many different symbol systems have been proposed in AAC intervention. Examples include Blissymbolics (Wood, Storr, & Reich, 1992), Picsyms (Carlson, 1985) and Picture Communication Symbols (PCS; Johnson, 1994). Beukelman and Mirenda (1998) noted that research that directly compares these various symbol systems is lacking. Summaries of the research indicate no conclusive evidence that one system provides significant advantages (Beukelman & Mirenda, 1998; Fuller & Lloyd ,

1997). Further research is warranted before conclusions can be drawn regarding the best symbols systems for augmentative communication systems.

Another avenue of research focused on the possible benefits of certain instructional strategies. The instructional strategies refer to the methods used for organizing and training the symbols. Numerous studies are available that addressed either training or organization of symbols (Burkhart, 1994; Calculator & Luchko, 1983; Goossens', Crain, & Elder, 1992; Kaiser, Yoder, & Keetz, 1992; Mirenda, 1985; Musselwhite & St. Louis, 1988; Romski & Sevcik, 1996). First those studies that addressed teaching strategies will be reviewed.

Teaching Strategies

Teaching strategies are the methods AAC facilitators use to train a variety of symbol comprehension and production skills, such as one-word labeling skills, symbol recognition, symbol combinations, and the more complex language skills needed for communication. There are a variety of approaches that have been described in the AAC literature. Examples include general language training approaches that have been applied to AAC such as structured approaches, milieu teaching, and interactive models; as well as approaches designed specifically by AAC facilitators such as aided language stimulation and the System for Augmenting Language (SAL; Beukelman & Mirenda, 1998; Goossens' & Crain, 1986; Romski & Sevcik, 1992, 1993,1996). There are studies that document the effective use of each of these approaches for promoting different aspects of language learning among AAC users (Basil & Soro-Camats,1996; Girolametto, Steig Pearce, & Weitzman, 1996; Goossens', 1989; Hemmeter & Kaiser, 1994; Iacona & Duncum, 1995; Kaiser et al., 1992; Romski & Sevcik, 1996; Romski, Sevcik, Robinson, & Bakeman, 1994). For example, training studies have shown that structured approaches, milieu teaching, and interactive models were effective for training initial symbol vocabulary

vocabulary (Girolametto et.al.,1996; Goossens', 1989; Hemmeter & Kaiser, 1994; Iacona & Duncum, 1995; Kaiser et al., 1992) . Those approaches designed specifically for AAC intervention, aided language stimulation and SAL, have proven to be more successful in facilitating functional communication skills (Basil & Soro-Camats,1996; Romski & Sevcik, 1996; Romski et al., 1994). For the purpose of the present study an interactive training model was used to facilitate acquisition of the graphic symbol vocabulary.

Organizational Strategies

Organizational strategies are another aspect of instruction that have been investigated in research on ways to promote language learning and effective communication among AAC users. Organizational strategies are the methods used to arrange the symbols on a AAC user's communication display. Examples of strategies include environment or activity display, semantic categories, and grammatical categories.

Environment or activity displays organize the needed vocabulary for specific activities. The vocabulary placed on overlays or on a single page of a dynamic screen matches the activity the user is participating in (see Musselwhite & St. Louis, 1988, for examples). To better organize activity displays, Mirenda (1985) proposed strategies such as divider tabs on communication books and dynamic displays, or a page on the dynamic display that listed the individual activity displays that contained the vocabulary for each activity.

Burkhart (1994) identified the natural branching capabilities of dynamic display devices as a means for organizing vocabulary. Specific vocabulary pages would be linked in a manner that would promote sentence construction. Burkhart (1994) suggested that the first part of sentence (e.g., I need) would appear on the first page and when a selection was made, a natural branch to the second page would occur. Vocabulary needed to complete the desired phrase would appear on the second page (e.g., the paint). Sentences

could be even more complex if the branches were available to specific characteristics such as color, size, and shape (e.g., the big, red crayon, the round cookie cutter).

A second organizational strategy implemented by AAC facilitators is semantic categorization (Beukelman & Mirenda, 1998). Symbols are organized in categories based on their semantic relation as decided by the AAC specialist. One type of semantic category is based on conceptual relationships such as food, clothing, friends, personal care and family members. A page would consist of the words within a category such as food vocabulary or clothing vocabulary. Of all the methods, this is thought to be the "least likely to facilitate language learning because of its nonlinguistic nature" (Beukelman & Mirenda, 1998, p. 343).

A final organizational strategy that facilitators have explored is the use of grammatical categories. This strategy has a long history within the field of AAC and involves organizing symbols by grammatical function (Brandenberg & Vanderheiden, 1988). An early example was proposed by McDonald and Schultz (1973) who arranged symbols from right-to-left across a page in categories who, doing, modifiers, what, where, and when. This approach is referred to as the Fitzgerald Key which was developed to teach language to a hearing-impaired child (Brandenberg & Vanderheiden, 1988). The intention of the Fitzgerald key was to facilitate word-by-word sentence construction. The original Fitzgerald key was modified by Bruno (1989) to cluster symbols in a left-to-right manner in categories such as people, verbs, adjectives, prepositions, object nouns, and place words. Burkhart (1994) described a dynamic display system in which vocabulary was organized using grammatical categories within each activity. For example, a display for an art activity would include people (e.g., teacher, classmates), the verbs (e.g., draw, cut, paint), the adjectives (e.g., big, little, red), and so forth.

Collectively, the information available on teaching and organizational strategies makes it clear that there are many approaches available to an AAC facilitator. However, many of these strategies lack empirical evidence to demonstrate how they improve the language abilities of AAC users. The recommendations in the literature are based on individual case studies in which a single teaching strategy or organizational strategy was employed. Studies directly comparing different teaching techniques or organizational strategies are lacking. One of the reasons for the limited research is the fact that individuals who need AAC represent a low incidence population, about 8-12 individuals per 1,000 in the general population (Beukelman & Mirenda, 1998). It is difficult to recruit individuals who actually use AAC systems to participate in training studies. One approach to this problem is to examine the effectiveness of AAC strategies and techniques with individuals who are not disabled prior to using those approaches with persons who have severe speech impairments (Mizuko & Esser, 1991; Ratcliff, 1994). It would be possible to investigate the usefulness of different organizational strategies with age peers who do not have speech impairments.

A review of the research in the area of AAC instruction revealed a number of areas in which additional research is needed. One need is to examine how symbol organizational strategies affect children's ability to produce complex grammatical sentences. This is an important area of research because it has been demonstrated that AAC users have deficits in areas of syntax as well as grammatical morphology (Basil & Soro-Camats, 1996; Smith, 1996; van Balkom & Welle Donker-Gimbrere, 1996; von Tetzchner & Martinsen, 1996). For example, young AAC users were observed to produce sentences that were shorter in length and omitted grammatical morphemes such as past tense (climb/climbed). Young AAC users also are inclined toward delays in literacy learning. Some authors have attributed this to language learning deficits as well as limited literacy experiences during

the preschool years. Young AAC users may have limited exposure to story books because of their limited ability to manipulate books and other printed materials, and few opportunities to re-tell stories because of their severe expressive communication deficits. These findings have led to the research question being addressed in the present study. The question posed is how will different symbol organization strategies affect a young child's retelling of a children's story. Analysis of the transcripts of the stories told by each child will allow the examination of how different symbol organizational strategies affect syntactic aspects of sentence construction as well as aspects of story structure.

In order to investigate the influence of symbol organizational strategy two alternate versions of a grammatical category strategy were used (Beukelman & Mirenda, 1998; Brandenberg & Vanderheiden, 1988; Burkhart, 1994; Calculator & Luchko, 1983). In one type of screen design, a single sheet display (Brandenberg & Vanderheiden, 1988) was designed on which all the symbols are arranged to resemble a modified Fitzgerald Key for categorizing vocabulary (Brandenberg & Vanderheiden, 1988; Calculator & Luchko, 1983; McDonald & Schultz, 1973). In this approach to symbol organization, the symbols are broken down into categories (e.g., who, doing, what) and arranged from right to left on a single page. All of the symbols within a category (e.g., doing) will appear in a single column or adjacent columns. The second design employed multiple sequential displays (Brandenberg & Vanderheiden, 1988), where one page follows another until the utterance is complete. This design also employs the modified Fitzgerald key. However, the pages follow a natural branching progression (Burkhart, 1994), in which each page corresponds to a grammatical function (e.g., who, doing) and selections on a page branch to other pages containing additional, appropriate vocabulary selections. Each page is designed based on the same vocabulary organizational strategy; however, the designs offer different advantages and disadvantages to sentence composition.

Composing a sentence with either a single page or multiple page design can yield the same product. There are advantages and disadvantages that each screen lends to the user in the process of composing the end product. Within the multiple sequential display design, grammatical order of certain types of sentences is imposed by the order of the pages. The single sheet display does not restrict the order in which symbols can be composed because all vocabulary is integrated onto one page. The amount of vocabulary that can be stored on a single page is determined by the capabilities of the device. The amount of vocabulary that can be placed on a single sheet display is therefore limited. Multiple pages within a multiple sequential display allow for increased vocabulary possibilities per grammatical function (e.g., who, doing). These proposed differences are issues that have lead to specific questions which were addressed by this study.

1. Does organizing vocabulary by grammatical structure utilizing a single screen design or a multiple screen design have an effect on the accuracy of a sentence imitation task?

2. Does the use of a grammatically organized single sheet design or multiple sheet design for a story construction task create a specific advantage to children for spontaneous sentence generation?

3. Do sentences generated with each screen design differ from orally generated sentences?

CHAPTER 2

METHODS

Subjects

Six first grade children with no history of speech-language impairments participated in this study. Three males and three females were selected from the same first grade classroom at a university affiliated school. The children were randomly assigned to different roles within the study. Two of the children participated in a preliminary phase of the study as vocabulary informants to collect a vocabulary sample of an orally told children's story (Ten Little Bears, Hauge, 1999). The remaining four children participated in the experimental phase of the study. These four children were randomly assigned to two groups. Each group consisted of one male and one female ranging in age from 6 years 5 months to 7 years. The children assigned to Group A learned to use a single sheet display voice output device, while the children in Group B learned to use a multiple sequential display design. The study was conducted in the month of October, approximately two months after the start of first grade. Upon the conclusion of the study, the students' teacher was asked to informally rank each student based on her knowledge of their level of reading ability. According to the teacher, the informal estimate of reading level is based on the reader's proficiency in ability to blend words (e.g., CVC, CVCV), read sentences with increased length and complexity, and recognize sight words. The male in Group A was ranked to be reading at a beginning first grade level and the female, middle first grade level. The male in Group B was ranked to be reading at an end first grade level and the female, at a middle first grade level.

Technology

The DynaVox Windows 2.0 (DynaVox Systems Inc., 1998) computer software was used to create the two different screen designs utilized in this study. This is the same

software found on the DynaVox Systems dedicated voice output communication devices such as the Dynamite (DynoVox Systems Inc., 1998). For the present study the voice output device was a Fujitsu C350 Lifebook, loaded with the DynaVox Windows 2.0 which includes DECtalk voice synthesis software. The software allows for individual page creation and linking. Dynasyms (Carlson, 1985), which are the standard graphic symbol set for the program, were used. In designing a page, the author selected the appropriate graphic picture symbols. These symbols were associated with words that the device spoke or buttons used for changing pages.

Sessions

Each research subject participated in five sessions. The sessions were approximately thirty minutes in length and the persons present included the researcher and the subject. During the sessions the subjects learned the Dynasyms vocabulary needed to participate in the study and how to operate the voice output communication device. The device was accessed by using an external mouse.

The first session was a vocabulary introduction phase of the study. Vocabulary was introduced in the same manner to each treatment group to ensure consistency across the groups. The subjects were presented with symbols that represent the vocabulary and screen controls needed to participate in the study. In teaching the symbols the experimenter showed the children a sheet of paper containing all of the symbols arranged in rows and columns in a random order. The experimenter revealed one row of symbols at a time and named each symbol and provided a brief verbal explanation of why the symbol represents a particular vocabulary item (e.g., show the symbol go, say "this symbols means go; the man on the symbol looks like he is running"). These procedures were repeated for each symbol. After completing a row of symbols the experimenter conducted a preliminary test of symbol comprehension by asking the child to point to each of the

symbols in that row. For any symbol not identified correctly the instruction procedures for that symbol were repeated. Final testing of receptive knowledge of the symbols was conducted using a multiple choice format at the end of the session. Three symbols were placed in front of the children and they were asked to point to the symbol named by the experimenter (e.g., "show me (dog)"). The test was repeated for each of the symbols in a group of three and there were a total of 70 symbols. A 100% receptive knowledge criteria was needed for progression to the next step in the training to assure that the children would recognize all of the symbols used in the sentence imitation task.

The second session was the sentence imitation phase of training during which time the subjects learned how to activate the voice output device. Each group was introduced to their respective page designs and learned how to generate sentences using that design by imitating the experimenter. The session progressed in three steps. The first step was an introduction of the page design through modeling of sentences using the interactive model technique (Girolametto et al., 1996). Using this technique, the experimenter verbally told the subjects the sentence to be reproduced. Then the experimenter generated that sentence using the voice output device in the same manner the subjects were asked to use. In step two, a series of sentences were imitated by the subject using the assigned page design. The experimenter said, " this is how to say (sentence)" and then showed them how to generate the sentence using the device. Then the experimenter asked the subjects to produce the same sentence using the voice output device. Any errors were identified at that point and corrected. Step three included a series of 10 test sentences imitated by the subjects without any correction. The results of the test sentences were recorded by the experimenter and any errors noted. Each sentence was timed and no subject was allowed more than two minutes on a sentence, so the maximum time to complete this task could have been 20 minutes.

The third and fourth sessions were identical in nature. The reading a book task for elicitation of a language act was used (Harste et al., 1984) and was referred to as the Computer Generated Story Task (CGST). Prior to beginning the reading a book task, the experimenter explained to the subjects that they had been taught how to use the voice output device to produce sentences and now they were to tell a story using the same device. They were also told that the way they picked the symbols to make sentences was the same way they were to use the device now. During session three and four the subject looked through the book Ten Little Bears (Hauge, 1999), and then was asked to read or pretend to read the book using the voice output device. The symbols the subjects selected while telling the story were recorded during each session. While using the device to generate a story the subjects were reminded not to use their own oral speech.

During the final session the subjects used their own oral speech to tell the story Ten Little Bears. This was referred to as the oral reading task. The subject's oral reading task was audio recorded and then transcribed.

Vocabulary Selection

In order to design the screens used by Groups A and B, it was necessary to determine the vocabulary children might use in telling the story prior to the study. Two of the six children who participated in the study were selected to provide information about appropriate vocabulary for telling the story. These children looked through the book Ten Little Bears (Hauge, 1999), and then they were asked to read or pretend to read the book out loud. The story was recorded and then transcribed. The primary source of vocabulary used in programming was selected from the transcriptions acquired from these two subjects. It was selected based on specific terms or synonyms observed in each transcription. Supplemental vocabulary was utilized if it was deemed necessary to form grammatically complete sentences or additional vocabulary needed in the experimenter's

judgment. The vocabulary selected from the non-grouped subjects oral readings is shown below. A total of 70 graphic symbols were available to the two groups. The symbols were separated into nine different grammatical categories.

Noun-26	baby	castle	ice	snow	umbrella
	balloon	cloud	mouse	snowman	water
	bear	duck	rabbit	tree	
	bed	ghost	sailboat	tree house	
	bee	hockey	sand	tricycle	
	bug	home	sky	turtle	
Verb-20	building	fishing	playing	sitting	
	climbing	going	riding	skating	
	cooking	looking	rolling	sleeping	
	crying	making	running	swimming	
	falling	painting	scared	talking	
Auxiliary Verb-3	are	is	were		
Adjective-11	eight	little	one	six	three
	four	nine	seven	ten	two
	five				
Article-1	the				
Pronoun-2	he	they			
Preposition-5	at	in	on	out	up
Conjuction-1	and				
Transitional-1	then				

Data Analysis

In a 1996 study van Balkom and Welle Donker-Gimbrere analyzed the picture description tasks of children who used augmentative communication during conversational task. The procedures detailed in this study were the basis for the analysis of the data obtained in the present study. The researcher made the determination through teacher interview, that each child's current level of language functioning and literacy experience was similar. To determine differences in sentence construction utilizing different screen

designs, specific sentence analyses resembling those in the van Balkom and Welle Donker-Gimbrere (1996) study were thought to be appropriate. Transcriptions from the sentence imitation task, computer generated story task, and the oral reading task were analyzed using a combination of the following categories: (a) total symbols (i.e., words), (b) total number of sentences, (c) imitation percent, (d) words per sentence, (e) total time, (f) words per minute, (g) frequency of words per grammatical category. Informal observations were also recorded by the examiner during all phases of the study. These were used to clarify results when needed.

The results from the sentence imitation task were analyzed first to examine the effects of the two screen designs on sentence imitation. The results from the CGST were analyzed second to determine the effects of screen design on story telling. Comparisons were also made among the subjects' performance on the sentence imitation task, CGST, and oral telling.

CHAPTER 3

RESULTS

Sentence Imitation

Utilizing the computer to imitate sentences was the first experience both groups had with either screen design. The sentence imitation task contained a total of 10 sentences to be imitated with a total of 62 words. There were 12 articles, 1 adjective, 13 nouns, 5 pronouns, 11 auxiliary verbs, 11 verbs, 1 transitional, 2 conjunctions, and 6 prepositions used in the 10 imitation sentences. Table 1 shows the individual results of each subject.

Table 1
Frequency of Imitated Vocabulary for a Sentence Imitation Task for Male and Female Subjects

	Test	Single Screen		Multiple Screen	
Vocabulary	Sentences	Female	Male	Female	Male
Articles	12	3	9	9	12
Adjectives	1	1	1	1	1
Nouns	13	12	11	11	12
Pronouns	5	5	5	5	5
Aux Verbs	11	4	8	10	11
Verbs	11	9	9	7	11
Transitions	1	0	0	1	1
Conjunctions	2	0	0	2	2
Prepositions	6	4	4	4	6
Possible Total	62	62	62	62	62
Words Imitated	n/a	43	47	50	62
Imitation %	n/a	69	76	81	100
Time	n/a	6:40	13:06	13:27	7:24
Words/Sec	n/a	0.11	0.06	0.06	0.14

The four subjects took between 6 minutes, 40 seconds and 13 minutes, 27 seconds to complete the sentence imitation task. As shown in Table 1, the male and female subjects utilizing the multiple screen design were able to imitate an increased number of transitions, verbs, auxiliary verbs, articles and conjunctions. Thus, they also imitated a higher number of words and produced a higher imitation percent compared to the male and female subjects using the single screen design. The male multiple screen design user was the only subject to gain a 100% accuracy on the imitation task. The female single screen design user presented with the lowest number of words imitated. This was attributed to limited imitation of auxiliary verbs and articles as compared to the others. It is also noted that the female single screen user and the male multiple screen user both had the highest word/sec rating, while the female had the lowest word count and the male had the highest word count.

Single Screen

Group A completed the sentence imitation task and the CGST utilizing the single screen design. Table 2 shows individual results for the sentence imitation task, CGST, and oral reading. As can be observed the words/sentence ratio was higher for the imitation task than for the first CGST for both the female and male. A greater words/sentence ratio was achieved by both the female and male subjects during the second CGST compared to both the imitation task and the first CGST. Table 2 shows both CGST's yielded between 9-10 sentences. It was noted that the female produced more words/sentence in less amount of time during the second CGST, while the male took more time in the second CGST than the first CGST. The female also produced more sentences in the shortest duration of time during the oral reading task. The male produced 44 total words in his oral telling while the average in his computer generated stories was also 44. It was noted that the male took 36 seconds to complete his oral reading.

Table 2
Frequency of Vocabulary for the Sentence Imitation Task (SI), the CGST, and Oral Reading (Oral) for Male and Female Subjects Using the Single Screen Design

	Female				Male			
Vocabulary	SI	CGST1	CGST2	Oral	SI	CGST1	CGST2	Oral
Interjections*	0	0	0	0	0	0	0	1
Articles	3	0	0	2	9	4	10	3
Adjectives	1	12	10	10	1	0	1	1
Nouns	12	17	19	12	11	7	12	6
Pronouns	5	0	0	18	5	9	5	9
Aux Verbs	4	0	6	16	8	1	8	2
Verbs	9	4	9	19	9	7	8	12
Transitions	0	0	0	9	0	0	0	0
Conjunctions	0	0	0	9	0	0	0	1
Prepositions	4	2	9	2	4	4	7	2
Adverbs*	0	0	0	23	0	0	0	7
Total Time	6:40	11:21	9:15	2:29	13:06	7:03	10:47	0:36
Total Words	43	35	49	120	47	33	51	44
Sentences	10	10	10	19	10	9	9	12
Words/Sent	4.3	3.5	4.9	6.32	4.7	3.67	5.67	3.67

Note.* Grammatical categories not available as a vocabulary choice.

Use of grammatical categories was another effect detailed by Table 2. The female subject produced words in 7/9 grammatical categories excluding transitions and conjunctions in the imitation task. The CGSTs included use of 4/9 grammatical categories excluding articles, pronouns, auxiliary verbs, transitions, and conjunctions in the first, and 5/9 excluding articles, pronouns, transitions, and conjunctions in the second. The female's oral reading was composed of 9/9 grammatical categories plus adverbs. The male subject produced words in 7/9 grammatical categories excluding transitions and conjunctions in the imitation task. The CGSTs included use of 6/9 grammatical categories excluding adjectives, transitions, and conjunctions in the first, and 7/9 excluding transitions, and

conjunctions in the second. The male's oral reading was composed of 9/9 grammatical categories plus one interjection and adverbs.

In order to compare the subject's computer generated readings and oral readings the two CGST totals were averaged. Results in Table 3 represent averaged individual sentence grammar results for the CGSTs being compared to oral reading results.

Table 3
Frequency of Grammatical Categories Used by Group A In the Average of Two CGSTs and the Oral Reading Task

	Female		Male	
Vocabulary	CGST Avg	Oral Read	CGST Avg	Oral Read
Interjections*	0	0	0	1
Articles	0	2	7	3
Adjectives	11	10	0.5	1
Nouns	18	12	9.5	6
Pronouns	0	18	7	9
Aux Verbs	3	16	4.5	2
Verbs	6.5	19	7.5	12
Transitions	0	9	0	0
Conjunctions	0	9	0	1
Prepositions	5.5	2	5.5	2
Adverbs*	0	23	0	7

Note. * Grammatical categories not available as a vocabulary choice.

As shown by Table 3, the female subject's CGSTs utilized 5/9 grammatical categories for sentence production. It is noted that 56% of those words generated in a CGST where nouns and verbs. This compared to the female utilizing 10 grammatical categories for oral reading, while generating 26% of the total words as nouns and verbs. It can be observed that the male subject's CGSTs utilized 7/9 grammatical categories for sentence production. The words in the CGST for the male were comprised of 40% nouns and

verbs. This compared to the male using 11 grammatical categories in the oral reading, while generating 41% of the words as nouns and verbs.

Multiple Screen

Group B completed the sentence imitation task and the CGST utilizing the multiple screen design. Table 4 shows individual results for the sentence imitation task, CGST, and oral reading.

Table 4
Frequency of Vocabulary for the Sentence Imitation Task (SI), the CGST, and Oral Reading (Oral) for Male and Female Subjects Using the Multiple Screen Design

	Female				Male			
Vocabulary	SI	CGST1	CGST2	Oral	SI	CGST1	CGST2	Oral
Interjections*	0	0	0	0	0	0	0	0
Articles	9	6	1	6	12	6	3	3
Adjectives	1	10	13	0	1	0	0	17
Nouns	11	16	15	8	13	9	6	23
Pronouns	6	0	0	12	5	11	10	0
Aux. Verbs	10	12	13	10	11	10	10	17
Verbs	7	11	13	12	11	13	11	16
Transitions	1	0	0	0	1	0	0	0
Conjunctions	2	4	4	0	2	0	0	2
Prepositions	4	3	2	7	6	9	6	5
Adverbs*	0	0	0	0	0	0	0	0
Total Time	13:27	15:31	10:19	0:35	7:42	16:53	10:25	2:38
Total Words	51	67	61	55	62	58	46	85
Sentences	10	8	9	10	10	10	10	14
Words/Sent	5.1	8.38	6.78	5.5	6.2	5.8	4.6	6.07

Note. * Grammatical categories not available as a vocabulary choice.

As shown in Table 4 the words/sentence ratio for both CGSTs was higher than the sentence imitation task for the female. However, the male presented with a lower words/sentence ratio for both CGSTs as compared to the sentence imitation task. Both

subjects' total words and words per sentence ratio decreased in the second CGST as compared to the first. A closer look, indicated that the female produced five fewer articles accounting for 90% of the difference. Three of the articles used by the female in the first CGST were unnecessary uses (i.e., the nine bear). The use of the article in that manner was dropped in the second CGST. A closer look, indicated the male produced fewer articles, nouns, prepositions, and verbs. A decrease in three prepositional phrases in the second CGST accounted for the decrease in total words. The subjects produced 8-10 sentences within both CGSTs. Both the male's and female's total time, total words and words/sentence ratio were lower on the second CGST when compared to the first CGST. The female produced 55 total words in her oral reading while in the CGSTs she produced an average of 64 total words. It was noted the oral reading task took 35 seconds. The male produced 85 total words in the oral reading task, while in the CGSTs he produced an average of 52 total words and more sentences.

The female subject produced words in 9/9 grammatical categories in the imitation task. The CGST's included use of 7/9 grammatical categories excluding pronouns, and transitions in the first CGST, and 7/9 excluding pronouns and transitions in the second. In the oral reading the female produced 6/9 grammatical categories excluding adjectives, transitions and conjunctions. The male subject produced words in 9/9 grammatical categories in the imitation task. The CGSTs included use of 6/9 grammatical categories excluding adjectives, transitions, and conjunctions in the first, and 6/9 excluding adjectives, transitions and conjunctions in the second. In the oral reading the male produced 7/9 grammatical categories excluding pronouns and transitions.

In order to compare the subject's computer generated readings and oral readings the two CGST totals were averaged. Results in Table 5 represent averaged individual sentence grammar results for the CGSTs being compared to oral reading results.

Table 5

Frequency of Grammatical Categories Used by Multiple Screen Design Subjects in the Two CGSTs and the Oral Reading Task

	Female		Male	
Vocabulary	CGST Avg	Oral Read	CGST Avg	Oral Read
Interjections*	0	0	0	0
Articles	3.5	6	4.5	3
Adjectives	11.5	0	0	17
Nouns	15.5	8	7.5	23
Pronouns	0	12	10.5	0
Aux Verbs	12.5	10	10	17
Verbs	12	12	12	16
Transitions	0	0	0	0
Conjunctions	4	0	0	2
Prepositions	2.5	7	7.5	5
Adverbs*	0	0	0	0

Note. * Grammatical categories not specifically programmed on the computer

As shown in Table 5 the female subject's CGSTs utilized 7/9 grammatical categories for sentence production. It is noted that 43% of the words in the CGSTs were nouns and verbs. This compared to the female utilizing 6 grammatical categories for oral reading, while generating 36% of the total words as nouns and verbs. It can be observed that the male subject's CGSTs utilized 6/9 grammatical categories for sentence production. The male generated 38% of the words in the CGSTs as nouns and verbs. This compared to the male using 7 grammatical categories in the oral reading, while generating 46% of the words as nouns and verbs.

Group Comparison

The four subjects completed the CGST utilizing the same vocabulary. The vocabulary for Group A was placed on a single screen design and for Group B the vocabulary was placed on a multiple screen design. To facilitate comparison across the two screen designs, the results for both the single screen and multiple screen groups are

shown in Table 6. The three trends from the CGST included: total word usage, total time usage, and grammatical category differences.

Table 6
Vocabulary Used In Nine Grammatical Categories and Summary Measures for the Single Screen and Multiple Screen Design for the CGST

	Single Screen				Multiple Screen			
	Female		Male		Female		Male	
Vocabulary	CGST 1	CGST 2	CGST 1	CGST 2	CGST 1	CGST 2	CGST 1	CGST 2
Articles	0	0	4	10	6	1	6	3
Adjectives	12	10	0	1	10	13	0	0
Nouns	17	19	7	12	16	15	9	6
Pronouns	0	0	9	5	0	0	11	10
Aux. Verbs	0	6	1	8	12	13	12	10
Verbs	4	9	7	8	11	13	13	11
Transitions	0	0	0	0	0	0	0	0
Conjunctions	0	0	0	0	4	4	0	0
Preposition	2	9	4	7	3	2	9	6
Total Time	11:21	9:15	7:03	10:47	15:31	10:19	16:53	10.25
Total Words	35	49	33	51	67	61	58	46
Sentences	10	10	9	9	8	9	10	10
Words/Sent	3.5	4.9	3.67	5.67	8.38	6.78	5.8	4.6

One of the trends noted was whether children increased or decreased their total word use from telling one to telling two. In Group A, both subjects had an average of a 16 word increase from the first CGST to the second. In Group B, both subjects had an average of a 9 word decrease from the first CGST to the second. It was noted that only the female in Group B had an increase of one sentence from the first CGST to the second.

The total time spent telling the stories was considered next. In Group B, both subjects had an average of a 5 minute, 50 second decrease from the first CGST to the second. In Group A results were variable. The female subject had a 2 minute, 6 second

decrease, while the male had a 3 minute, 45 second increase in total time from the first CGST to the second.

Differences in the use of grammatical categories were also observed. The male in Group A utilized pronouns in both the first and second CGST, while the female did not use pronouns in either telling.. The male, in Group B presented with a similar pattern of use pronouns in both the first and second CGST, while the female did not use pronouns in either telling. Across groups it was noted that Group B used more auxiliary verbs and verbs in both CGSTs as compared to Group A. It was noted that only the female in Group B utilized conjunctions and used them in both CGSTs.

The three trends observed in Table 6 were supplemented by analysis of transcripts of the CGSTs. Transcriptions of both groups CGSTs were analyzed in order to attempt to uncover possible distinguishable characteristics that may differentiate the two screen designs. The most distinguishable characteristic was sentence length. The shortest and longest sentence each user produced was noted as well as its grammatical complexity. The actual sentences produced by the subject are denoted in parenthesis.

In Group A, the female's shortest sentence was two words consisting of a noun and a verb in the first CGST (ice bear). The longest sentence in the first CGST was five words consisting of an adjective, two nouns, a verb, and a preposition (five bear playing in water). In the second CGST, the female's shortest sentence was two words consisting of one adjective and one noun (10 bear). The longest sentence was six words consisting of an adjective, two nouns, an auxiliary verb, a verb and a preposition (4 bear are playing in tree). The male subject's shortest sentence in the first CGST was two words consisting of a pronoun and a verb (they playing). In the first CGST, the male's longest sentence was five words consisting of one pronoun, one verb, one preposition, one article, and one noun (they climbing up the tree). The male's shortest sentence in the second CGST was four

words consisting of one article, one noun, one auxiliary verb, and one verb (the ghost is crying). The subject's longest sentence was seven words long and consisted of two articles, two nouns, one auxiliary verb, one verb, and one preposition (the baby is looking at the tree).

In Group B, the female's shortest sentence in the first CGST was four words consisting of an adjective, a noun, a auxiliary verb, and a verb (1 bear is sleeping). The longest sentence was 12 words consisting of an adjective, 3 nouns, 2 auxiliary verbs, 2 verbs, a conjunction, 1 preposition, and 1 article (1 bear is sleeping and the bear are looking in the home). In the second CGST, the female's shortest sentence was four words long consisting of an adjective, a noun, an auxiliary verb, and a verb (9 bear are skating). The longest sentence produced by the female was 11 words consisting of 2 adjectives, 3 nouns, 2 auxiliary verbs, 2 verbs, 1 preposition, and a conjunction (1 bear is sitting in umbrella and 5 bear are looking). The male's shortest sentence in the first CGST was four words consisting of a pronoun, an auxiliary verb, a verb, and a noun (they were playing ghost). The longest sentence was eight words consisting of two pronouns, an auxiliary verb, two verbs, a preposition, an article, and a noun (they were making he going two the sky). In the second CGST, the male's shortest sentence was three words consisting of a pronoun, an auxiliary verb, and a verb (he were sleeping). The longest sentence produced by the male was seven words consisting of a pronoun, an auxiliary verb, a verb, two prepositions, an article, and a noun (he were playing two in the sky). It must be mentioned that the verb "was" was not a vocabulary item programmed into the computer. The male in Group B choose to substitute another verb instead.

CHAPTER 4

DISCUSSION

AAC technology and its use is driven by the central goal of AAC. AAC specialists are attempting to provide individuals with the opportunity and capability to communicate, participate, and learn their native language. The present study addressed questions about the use of a branching vocabulary organization design versus a single page design for a voice output, high technology communication device in regards to a child's ability to tell a story. The questions were addressed through a sentence imitation task, a computer generated story task referred to as a CGST and an oral reading task. The three questions posed were: (a) Does organizing vocabulary by grammatical structure utilizing a single screen design or a multiple screen design have an effect on accuracy of a sentence imitation task? (b) Does the use of a grammatically organized single sheet design or a multiple sheet design for a story construction task create a specific advantage to children for spontaneous sentence generation? (c) Do sentences generated with each screen design differ from orally generated sentences?

Sentence Imitation Effects

The sentence imitation task was the first experience users had with the computer and with the different screen designs. The preliminary findings from the present study suggest that screen design does have an effect on accuracy of sentence imitation. Group B, which utilized the multiple screen design presented with a higher imitation percent accuracy as compared to Group A, which utilized the single screen design. Of note was the fact that the single sheet design contained 70 symbols on a single page, and appeared to frustrate the children as it was difficult for them to find the symbol they desired. The female single sheet user was noted to accept partially imitating sentences (i.e., baby

running) and state "I'm done." This resembled what researchers reported they were finding in AAC users. The research suggested that syntactic structure was characterized by a predominance of one- or two-word messages, unusual word order, omission of frequently appearing words, and limited complexity of syntactic structure (Basil & Soro-Camats, 1996; Smith, 1996; van Balkom & Welle Donker-Gimbrere, 1996; von Tetzchner & Martinsen,1996). The multiple screen users presented with an initial difficulty finding the page containing the desired symbol; however, they were also noted to flip between pages and scan each page looking for the symbol. This seemed to establish a pattern of scanning for the multiple screen users that was not duplicated in Group A. The users would start with one page, then scan the next, and so on. In contrast, the single sheet users attempted many different scanning techniques including linear row scanning and linear column scanning; however, never the same process. An interesting point was that each screen design was organized by grammatical category, which was proposed by Brandenberg and Vanderheiden in 1988 and supported by others (Bruno, 1989; Burkhart, 1994). The use of grammatical category organization across a multiple screen design provided a higher imitation accuracy percent and was observed to frustrate users less.

The previously described observations directly relate to two areas; visual scanning and visual attending. Mirenda (1985) outlined these two visual processes as being important considerations to designing a communication system. "Students with severe handicaps often have difficulty scanning complex visual arrangements" (Mirenda, 1985, p. 61). Mirenda (1985) also stated "Some students may exhibit very fleeting visual fixation and/or attention skills" (p. 61). In relation to this study the single sheet design supported research findings based on typical AAC users as mentioned in the previous paragraph. Observations were made that Group A was unable to establish a consistent scanning pattern. Group A produced one- or two-word phrases that lacked frequently occurring

words, and at times no verbs or auxiliary verbs. The multiple sheet design users in Group B were observed to establish a scanning pattern and were able to achieve a higher imitation percent accuracy rating and no less than an two nouns and a verb were imitated. The multiple sheet design also provides a very natural barrier between types of symbols and could be used to denote the grammatical function (i.e., all action symbols on this page). The difference between 70 symbols on one page versus 70 symbols spread across three pages also created specific advantages for multiple screen design users. It was not necessary for the multiple screen users to discriminate one grammatical category from the other, allowing for attention to be focused on finding the correct symbol.

Computer Story Effects

The findings regarding the CGST and the different screen designs revealed interesting implications for future AAC design. In regards to the second research question, the results suggested that the children who used the multiple screen design had an advantage over the children using the single screen design. A review of the analyses and informal observation during the CGST supported use of a multiple screen design organizational strategy. There was evidence that the multiple screen design yielded more efficient use. In addition, the evidence suggested that this design yielded levels of sentence production that seemed to exceed previous research findings. Previous research suggested that AAC users generated: (a) a predominance of one or two word messages; (b) word order deviation in simple phrases and compound sentences; (c) phrase construction characterized by successive nouns; (d) limited use of auxiliary verbs and negations (Basil & Soro-Camats, 1996; Smith, 1996; van Balkom & Welle Donker-Gimbrere, 1996; von Tetzchner & Martinsen, 1996). The evidence was especially interesting because it has implications for designing systems for children with severe communication disorders who must use AAC.

First, data suggested that the multiple screen design was associated with more effective use in the most natural communicative task, the CGST. The results indicated that each multiple sheet user produced more total words in the first CGST than in the sentence imitation. The single sheet users produced less total words in the first CGST than in the sentence imitation. There is a possibility that more symbols could be accessed and retained for independent sentence construction using the multiple sheet design. During the sentence imitation task it was informally observed that the multiple screen users had established a pattern of scanning while the single screen users had not. This was also observed in the first CGST. The multiple screen users appeared to have an established scanning pattern. It was shown in Table 6 that Group B, the multiple screen users, had an average of a 5 minute, 50 second decrease from the first CGST to the second. In Group A the results varied between an increase by the male user in total time and a decrease by the female of 2 minutes, 6 seconds. This indicated that the multiple screen design yielded more efficient use across two computer generated story construction tasks for a non-AAC user. If the multiple screen design is beneficial for a non-AAC user, then it also might be beneficial for an AAC user.

The implication that well designed AAC technology might facilitate sentence production and language use is supported by research on cognitive and language development software. Research based on two such software programs, the Program for Early Acquisition of Language (PEAL; Meyers, 1985), and the ALPHA program (Nelson, Prinz, & Dalke, 1989; Prinz, Pemberton, & Nelson, 1985) included work with language intervention utilizing a computer with children with Down's syndrome, developmental delay, hearing impairment, and significant motor impairments ranging from preschool age to early elementary age. Schery and O'Connor (1995) summarized studies utilizing these programs and stated:

> The results of the research on PEAL and the ALPHA programs are promising. This suggests that computer technology, when combined with software designed to support interactive, developmentally appropriate communication exchanges, can facilitate language development in a variety of children with special learning needs as they move from early symbolic skills to acquisition of initial vocabulary and early syntactic patterns expressed in verbal, written, or signed form. (p. 291)

The research points to use of computer programs in language activities to facilitate increased language acquisition in children with multiple disabilities. The evidence in the present study suggested that levels of sentence production utilizing a multiple screen design seemed to exceed those found with children who used a single screen design. Although this difference was found for children who did not require an AAC system, the result suggested that comparing single screen and multiple screen performance for children who do require AAC systems would be a fruitful avenue of research. Possibly, AAC users would exceed the levels of language production found in previous research if provided with a multiple screen device.

A review of the transcripts for the CGSTs of Group A and B were beneficial in producing evidence that supported use of a multiple screen design. First, Group A, the single screen users, produced minimum sentences that averaged 2.5 words in length and maximum sentences that averaged 5.75 words. Group B produced minimum sentences that averaged 3.75 words in length and maximum sentences that averaged 9.5 words. Group A's minimum sentence average closely compared to the research finding that AAC users generated a predominance of one or two word sentences. While no previous research was identified which addressed maximum sentence length, Group B was able to produce a substantially higher maximum sentence average as compared to Group A. The minimal sentences produced by Group A also resembled what researches described as a succession of nouns, and were limited in use of auxiliary verbs. The female single screen

user from Group A produced sentences such as "ice bear" and "ten bear." The male in Group A produced sentences such as " they playing." As shown in Table 6, Group B utilized more auxiliary verbs and verbs in both CGSTs as compared to Group A. The maximum sentence produced by a member in Group A "The baby is looking at the tree" differed in grammatical complexity from the maximum sentence in Group B, "One bear sleeping and the bear are looking in the home." This finding was further evidence for the increased performance in spontaneous sentence construction that was achieved utilizing the multiple screen design.

The advantage of using the multiple screen as compared to the single screen was not supported by the evidence which showed a decrease in total word usage across the two computer generated story tasks for the children in Group B. While Group A exhibited an increase of total words from the first CGST to the second, Group B exhibited a decrease. This decrease, however, might be explained as resulting from the elimination of unnecessary articles and reduction of prepositional phrases in the second computer generated story. Another possible reason could be a decrease in motivation to be explicit in detail, because the experimenter was acquainted with the story and viewing the same pictures. In spite of the apparent decrease in total words, the multiple screen design enabled non-AAC users to produce results that were more grammatically correct in less time than that of the single screen design as previously mentioned. Paired with the positive effects of cognitive and language software programs, implications are raised that a multiple screen organizational strategy could viably benefit AAC users. Present research has suggested that a multiple screen design could reduce visual scanning and discrimination demands, increase the chance for grammatical completeness, introduce grammatical categories with a natural barrier orientation, and reduce the time it takes to acquaint a child to a sentence construction task.

Some interesting informal observations were made, unrelated to the comparison of the screen designs, that had implications for AAC research. Both members of Group B and the male in Group A commented on the pluralization of nouns. The computer could say bear but not bears. The male in Group B also utilized the number "two" when he desired a sentence to use the word "to." He was also observed to use the auxiliary verb "were" and then state "I wanted it to say was." The female in Group B was noted to verbally state the computer did not contain the word "a." These observation illustrate the desire the users had to choose the words that were contained in their mental lexicon but not available in their expressive lexicon. It also directed attention to the limitations of vocabulary programming that might be addressed in future research.

Oral Reading

A comparison of the group's computer generated stories and subjects' oral story telling was conducted to explore differences. The results revealed differences in the stories; however, neither the computer generated nor oral stories were consistently favored. One consideration was that the computer generated stories were limited in vocabulary to 70 symbols while the oral stories were only limited to the child's expressive vocabulary. Research has shown that AAC users' sentences were predominantly one or two word messages, contained word order deviations, included phrases that were constructed using successive nouns, and exhibited limited use of auxiliary verbs and negations (Basil & Soro-Camats, 1996; Smith, 1996; van Balkom & Welle Donker-Gimbrere, 1996; von Tetzchner & Martinsen,1992). This research was based on conversational speech produced at school and home by individuals who had been using AAC technology because of a severe speech impairment. Evidence in the present study compared oral readings and computer generated readings produced by children who did not use AAC technology and did not have a speech impairment. Evidence indicated that

oral readings and computer generated stories differed; however, not in a consistent fashion. Rather, evidence supported a notion that stories were dependent upon the users' vocabulary choice.

The first evidence of the differences was found in the overall total words, words/sentence ratios, and total time. The female in Group A and the male in Group B produced more total words, a higher words per sentence ratio, and more sentences in their oral telling as compared to both computer generated tellings. They also took an average of 2 minutes and 33 seconds to tell their oral story. However, for the male in Group A and the female in Group B, oral tellings were comparable to their CGSTs, except in total time. They took and average 35.5 seconds for their oral stories and average of 10 minutes and 53 seconds for their CGSTs.

The number and types of grammatical categories used supported the notion that differences between oral readings and CGSTs were based on users' vocabulary choices. As shown in Table 3, the female in Group A used 5 grammatical categories in the CGSTs and 9 grammatical categories plus adverbs in her oral reading. The male used 7 grammatical categories in the CGSTs and 9 grammatical categories plus adverbs and interjections in his oral reading. The female in Group A produced a higher percentage of nouns and verbs in her CGSTs as compared to her oral reading. The male produced a similar percentage of nouns and verbs in both the oral reading and the CGSTs. However the results from Group B contradicted those from Group A. As shown in Table 5, the female in Group B used 7 grammatical categories in her CGSTs and 6 grammatical categories in her oral reading. The male in Group B used 6 grammatical categories in the CGSTs and 7 grammatical categories in the oral reading. The female produced a higher percentage of nouns and verbs in the CGSTs as compared to her oral reading. The male produced a higher percentage of nouns and verbs in his oral reading as compared to his

computer generated stories. Other inconsistent vocabulary choices were noted in use of specific grammatical categories. The female in Group A did not use any pronouns in the CGSTs, but did use pronouns in the oral telling. This was duplicated by the female in Group B. However, the male in Group B used pronouns in both CGSTs and did not use any in the oral reading. The female in Group B used conjunctions and adjectives in her computer generated telling and did not use conjunctions in the oral telling.

Conclusion

The present study addressed questions about the use of a branching vocabulary organization design versus a single page design for a voice output, high technology communication device in regards to a child's ability to tell a story. The questions were addressed through a sentence imitation task, a computer generated story task referred to as a CGST, and an oral reading task. The three questions posed were: (a) Does organizing vocabulary by grammatical structure utilizing a single screen design or a multiple screen design have an effect on accuracy for a sentence imitation task? (b) Does the use of a grammatically organized single sheet design or a multiple sheet design for a story construction task create a specific advantage to children for spontaneous sentence generation? (c) Do sentences generated with each screen design differ from orally generated sentences?

These preliminary findings suggested that organizing vocabulary by grammatical structure utilizing a multiple screen design was associated with greater accuracy for a sentence imitations task. There is not enough data to support a specific advantage to either design for a spontaneous sentence generation task; however, the data suggested benefits to the use of a multiple screen design versus the single sheet design. Data suggested that the amount of vocabulary contained within a page seemed to affect construction ability. Users of the multiple screen design appeared to attend to symbols

and form a pattern for scanning that was more effective for sentence imitation and sentence construction. It was also revealed that sentence length seemed to be affected by the screen design utilized in the sentence construction task. Finally sentences generated with each screen design differed from orally generated sentences. However, there was no specific pattern of difference that could be noted. This study was completed with non-AAC users with average intelligence and no speech or language impairments. Through review of literature and comparison of limiting factors presented by this study implications of potential benefits to AAC users might be established. One implication was that because the multiple screen grammatical organization strategy appeared to benefit a small sample of non-AAC users, future research should focus on examining this same phenomenon with a larger sample size of AAC users. Although this study showed that oral and computer generated story telling were different, the inconsistency in these differences is important to consider. Further research focused on the oral readings and computer generated stories of a larger sample size of non-AAC users is needed to determine the variables that influence both oral and computer generated story telling. These variables could include data collection on core vocabulary knowledge, expressive grammatical abilities, social linguistic abilities, and literacy learning experience tested prior to conducting research to establish a communication profile. Such information could be beneficial in AAC assessment procedures and vocabulary selection for devices utilized by AAC users. Although the subjects in the present study were assigned randomly to either the single screen or multiple screen condition a larger sample size would provide better control over individual variations such as knowledge of written text, understanding of and response to the task, and prior language abilities. The analysis of data in the present study included measures of sentence complexity and use of grammatical categories. However, there is need for additional types of data analysis such as narrative analysis to be

stories. Further, the types of stories the children in the present study told were influenced by the type of children's book selected, a counting book. Additional research with other types of stories would be warranted to possibly support the preliminary findings about the benefits of multiple screen versus single screen designs. Such information would contribute to the design of voice output communication devices and selection of developmentally appropriate vocabulary for children who require an AAC system.

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