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Enhancing the Use of Augmentative Communication Systems of Children with Autism Through Caregiver-Implemented Naturalistic Teaching Strategies

Débora R. P. Nunes
ENHANCING THE USE OF AUGMENTATIVE COMMUNICATION SYSTEMS OF
CHILDREN WITH AUTISM THROUGH CAREGIVER-IMPLEMENTED NATURALISTIC
TEACHING STRATEGIES

BY

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To my husband for his love and endless companionship

“Amorcito”, this is for you!

To my loving parents for their encouragement, dedication, and guidance throughout my life

Thank you for leading me here
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From this long journey, I’ve learned one enlightening perspective that I’ll keep for life:

"Deixa a vida me levar..."

Serginho Meriti/ Eri do Cais
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ABSTRACT

The effectiveness of using augmentative and alternative communication (AAC) for children who do not acquire functional speech or who have difficulty processing and comprehending spoken language is well documented in the literature. Considering that one of the core defining features of Autism Spectrum Disorder (ASD) is the inability to develop effective communication skills, children with ASD represent good candidates for AAC interventions. The research literature on autism has reported positive outcomes in communication intervention programs that start early, are held in the child’s natural environment, use naturalistic teaching strategies and include parents as intervention agents.

The purpose of this research project was to evaluate the effects of a caregiver-implemented AAC intervention on the communication performance of young children with ASD. A single-subject multiple-baseline design across routines with replications across participants was used to evaluate the effectiveness of the treatment. Four children (ages 4-8) diagnosed with ASD and their mothers participated in this study. Caregivers were taught to implement 4 naturalistic teaching strategies using AAC systems to enhance the communication skills of their children during home routines. The mothers effectively learned to apply the teaching procedures and generalize them to untrained routines. The four child participants increased their frequencies of communication turns (initiations and responses) using the AAC system across trained and untrained routines. These participants additionally increased their frequencies of verbalizations/vocalizations in at least one routine, while two children increased the use of gestures/manual signs. Two participants additionally increased the use of gestures. No significant changes were observed in the rate of imitative responses following intervention. Social validation data indicated that the three caregivers that completed the study were satisfied with the intervention program and perceived positive changes in their children’s communication using the AAC system.
INTRODUCTION

Impairments in verbal and nonverbal communication are core defining features of Autism Spectrum Disorder (American Psychiatric Association [APA], 1994). Expressive communication problems range from complete mutism to echolalia (National Research Council [NRC], 2001). Fifty percent of the people with autism are functionally mute; that is, they barely verbalize and whenever they do their verbal productions have no communicative functions (NRC, 2001; von Tetzchner & Martinsen, 2000). Eighty-five percent of those who do acquire speech are echolalic (Prizant, 1987). Studies have shown that persons with autism fail to compensate speech impairments with gestures or facial expressions (von Tetzchner & Martinsen, 2000). This population generally presents deficits in communicating for social purposes (Baron-Cohen, 1989; Wetherby & Prutting, 1984), orienting or attending to social partners or sharing affective or emotional states with others (Dawson, Hill, Spencer, Galpert & Watson, 1990; NRC, 2001; Wetherby, Prizant & Schuler, 2000). Persons with autism tend to avoid eye contact and exhibit limited use of symbolic communicative gestures, such as showing, waving, nodding or pointing (Tsai, 1998; Wetherby, 1986; Wetherby & Prutting, 1984;). In terms of comprehension, some individuals present deficits in processing audio-vocal information, such as verbal language (Vaughn & Horner, 1995) or understanding nonverbal forms of communication (NRC, 2001), such as conventional gestures (Sarria, Gomez & Tamarit, 1996).

The poor prognosis that individuals with autism have in developing language and communication skills warrants the need for interventions that focus on developing methods of communication for this population. The use of Augmentative and Alternative Communication (AAC) is one possible way to accomplish this objective. The American Speech-Language-Hearing Association defines AAC as:
"a set of procedures and processes by which an individual’s communication skills (i.e., production as well as comprehension) can be maximized for functional and effective communication. It involves supplementing or replacing natural speech and/or writing with aided (e.g. picture communication symbols, line drawing, Blissymbols, and tangible objects) and/or unaided symbols (e.g. manual signs, gestures, and finger spelling)” (ASHA, 2002).

Augmentative communication refers to the supplementation of natural speech or vocalizations that may be present. In other words, the use of **aided systems** (i.e. systems that require a physical object/device) or **unaided systems** (i.e. systems that do not require external physical object/device) utilized to clarify the interchange of ideas or information when speech is insufficient. Research has shown, however, that one in every 200 people is incapable of using speech for the purpose of communication (American-Speech-Language-Hearing Association, 1991). For these individuals, aided and unaided systems, such as communication boards, picture cards, voice output devices and sign language can serve as alternative communication means or the primary mode for comprehending or expressing language.

It is essential to implement effective language intervention strategies to instruct individuals with communication deficits how to use AAC systems in functional ways. This is particularly critical in children with autism, who typically fail to naturally compensate speech impairments with nonverbal forms of expression (von Tetzchner & Martinsen, 2000) and present major problems in generalizing social communication skills across settings and people (Hancock & Kaiser, 2002; Kaiser, Hancock & Nietfeld, 2000). As reported in the research literature, naturalistic teaching, as an intervention procedure, has been successfully implemented in AAC interventions to teach functional communication to children with ASD in natural language learning-settings (Cafiero, 2001; Hamilton & Snell, 1993; Kouri, 1998; Kravits, Kamps, Kemmerer & Potucek, 2002; Schepis, Reid, Behrmann, Sutton & Sutton, 1998; Stiebel, 1999). The combination of AAC with naturalistic strategies, such as environmental arrangement, mand-model and time-delay have been reported to enhance not only the use of aided forms of communication, but also increase the frequency of verbalizations of this population (Hamilton & Snell, 1993; Kouri, 1998; Kravits et al., 2002; Schepis, et al. 1998).

Studies have shown that treatment programs are effective not only when interventions focus on the social use of language and include natural language-learning settings (e.g. home, school or community); but also when treatment starts early and actively involve the individual’s
family (NRC, 2001; Wetherby & Prizant, 1992). In this scenario, it is pertinent to include caregivers of young children with ASD in AAC intervention programs. An alternative for promoting parental engagement in these endeavors is to train caregivers to become language intervention agents. Parents may function as effective therapists since they spend more time with their children and interact with them in a wider range of communication contexts than an educator or clinician (Dale, Crain-Thoreson, & Notari-Syverson, 1996; Kaiser, Hancock & Hester, 1998). Moreover, the active involvement of caregivers in AAC interventions may also enhance the use of aided and unaided systems of communication in the home and community settings. The underuse of such systems in these natural environments has been regarded as a critical issue in the AAC literature (Allaire, Gressard, Blackman & Holster, 1991; Angelo, 2000; Blackstone & Hunt Berg, 2003).

**Purpose of the Study**

Despite the importance of training parents to facilitate the use of AAC systems in the natural environment for individuals with ASD, limited research has been published in this topic (Hamilton & Snell, 1993; Stiebel, 1999). The purpose of this investigation is to evaluate the effects of a parent-implemented AAC intervention program on the communication outcomes of children with ASD in the home setting.

The specific research questions are:

*Question 1:* Can caregivers learn to implement naturalistic teaching strategies using visual-graphic systems of communication during home routines?

*Question 2:* What changes in the children’s communication modes (vocalization/verbalization; gestures/signs; and aided systems) frequency of communication turns (initiations and responses), and imitative responses are observed with the implementation of this intervention?

*Question 3:* How does the caregiver evaluate this intervention program?

*Question 4:* Does the caregiver perceive any changes in the child’s communication abilities following the intervention?
CHAPTER 1
REVIEW OF THE LITERATURE

The Implementation of Augmentative and Alternative Communication for Individuals with Autism Spectrum Disorder

The field of augmentative and alternative communication (AAC) has notably developed a number of intervention techniques for individuals with communication and language impairments in the last decades. In the present analysis, a critical examination of the studies published on AAC interventions with a focus on individuals with ASD will be discussed. The general purpose of this review is to verify the effectiveness of implementing AAC interventions with this population. This analysis will be guided by the following topics: (a) the types of communication systems used in AAC interventions with individuals with ASD; (b) participant characteristics; (c) language intervention goals; (d) types of intervention methods; (e) settings, generalization and duration; (f) reliability measures and social validation; and (g) effects of intervention.

Major peer-reviewed studies from the fields of special education and communication disorders published in the years 1980 through 2005 were consulted. The search method consisted of three strategies: computerized searches, hand searches and footnote inspection. Initially, a computerized database search using PsycINFO and Educational Resources Information Center (ERIC) was conducted. Then, a CD-Rom containing the first 13 years (1985-1997) of the journal Augmentative and Alternative Communication was hand searched. Finally, the use of other authors’ references was utilized.

The articles found in these references were included in this review considering three selection criteria. First, the investigations had to involve participants with a diagnosis of autistic
spectrum disorder (including autistic disorder, pervasive developmental disorder not otherwise specified [PDD-NOS], Asperger’s Disorder, and Childhood Disintegrative Disorder), using aided or unaided communication systems. Second, the study had to report measures of some aspect of language (form, content or use). Third, only studies that used empirically validated teaching methods were included in this analysis. For this reason, Facilitated Communication, which has been reported as a teaching strategy that lacks scientific evidence (NRC, 2001) was eliminated from this review. A total of 46 published studies were identified for this report.

**Types of Systems**

In this review, seventeen of the forty-six studies analyzed used total communication/sign language, or gestures as an alternative or augmentative system of communication. Nineteen investigations taught the participants to use visual symbols, such as pictures. Two investigations compared the use of visual graphic systems and manual signs. Five studies utilized voice output devices (VOD); and three studies used a “hybrid approach”, combining aided and unaided systems.

**Sign Language/Total Communication**

Sign language teaching has been in the autism literature for over thirty years and emerged as an alternative to speech training methods. Research from the early 70’s revealed that individuals with autism who were echolalic often benefited from speech training, whereas those who were mute generally did not (Lovaas, 1977). The use of sign language as an alternative form of communication is justified when considering that approximately fifty percent of people with autism are functionally mute (Rutter, 1978) and that even after years of intensive speech training, only about half of these individuals acquire spoken language (Seal & Bonvillian, 1997). The idea of using sign language rather than speech was based on the assumption that manual communication would be easier to generalize to nontreatment settings (Bonvillian, Nelson & Rhyne, 1981); that signs were more iconic and therefore required less symbolic processing than spoken language (Kiernan, Reid & Jones, 1982); that signs were easily molded/prompted and could be shaped in the absence of other social skills (Rotholz, Berkowitz & Burberry, 1989); and that the use of a visual-motor mode of communication would bypass the auditory-vocal processing difficulties (O’Connor, 1971) or deficits in auditory visual cross-modal associations.
(Fulwiler & Fouts, 1976) observed in this population. It was also claimed that sign language was
easier than speech for it requires lower cognitive prerequisite skills and also because signs are
similar to gestures, which are an ontogenetic precursor for spoken language (Bates, 1979).

In the last 25 years, the studies reported in the literature have evaluated the effects of
teaching expressive and receptive vocabulary using speech, manual signs, gestures, sign
language and total communication (speech and sign) on the language development of children
with autism (Barrera, Lobato-Barrera & Sulzer-Azaroff, 1980; Barrera & Sulzer-Azaroff, 1983;
Buffington, Krantz, McClannahan & Poulson, 1998; Carr & Kologinsky, 1983; Carr, Kologinsky
& Leff-Simon, 1987; Ferrarese & Norton, 1982; Layton, 1988; Rotholz et al., 1989; Schepis,
Reid, Fitzgerald, Faw, Pol & Welty, 1982; Wherry & Edwards, 1983; Yoder & Layton, 1988;).
Many of these investigations have compared the language gains of good and poor verbal
imitators when exposed to these various communication modalities (Carr & Dores, 1981; Carr et
al., 1984; Layton, 1988; Remington & Clarke, 1983; Yoder & Layton, 1988), while others have
focused on evaluating the effectiveness of assorted methods used for teaching sign language or
total communication to this population (Carr & Kologinsky, 1983; Kouri 1988; Sundberg,
Endicott & Eigenheer, 2000; Walker, Hinerman, Jenson & Peterson, 1982; Watters, Wheelers &

**Communication Systems that Use Visual-Graphic Symbols**

Visual-graphic symbols such as photographs and pictograms have been successfully incorporated
in AAC interventions with persons with autism and those presenting autistic-like behaviors
(Bondy & Frost, 1994; Cafiero, 2001; Charlop-Christy, Carpenter, Le, LeBlanc, and Kellet,
2002; Cummings & Williams, 2000; Frea, Arnold & Vittimberga, 2001; Ganz & Simpson, 2004;
Hamilton & Snell, 1993; Kravits et al., 2002; MacDuff, Krantz & McClannahan, 1993; Magiati
& Howlin, 2003; Mirenda & Santogrossi, 1985; Peterson, Bondy, Vincent, & Finnegan, 1995;
Rotholz et al., 1989; Schmitt, Alper & Raschke, 2000; Schwartz, Garfinkel & Bauer, 1998;
Stiebel, 1999; Tincani, 2004; Vaughn & Horner, 1995; vonTetzchner, Øvreeide, Jørgensen,
Oxholm, Ormhaug, Warne, 2004;). Some of the reasons for adopting graphic rather than manual
systems or speech training interventions are related to the fact that certain individuals with this
syndrome may present disorders in prerequisite skills or cognitive deficits essential for signing or
speaking. Specifically, these would include poor imitation skills (Klinger & Dawson, 1992;
Smith & Bryson, 1994) and motor functioning disorders (Seal & Bonvillian, 1997). The
information-processing problems and precisely working memory deficits presented by some of these individuals would also justify the use of nontransient systems of communication (Mirenda, 1985; Mirenda & Marthy-Laikko, 1989; Mirenda & Schuler, 1988; Schuler, 1995). These deficits relate to the difficulty that some persons with autism have in comprehending information that is sequentially coded or retrieving this type of stimuli. Spoken words, for instance, involve the production of sounds that are transient in nature and, therefore, fade over time. Specifically, the articulation of the next speech sound entails the termination of a previous one (Mirenda & Schuler, 1988) and, in a broader sense, the composition of a message involves the sequential emission of spoken words. In order to comprehend speech the listener relies on recall memory to retrieve sounds, combine them into words and further into meaningful information. In the same token, sign language is spatially configured in a sequential manner. Although the signs are less transient than speech sounds, they demand similar cognitive skills to be encoded and organized into comprehensible messages.

In this context, the use of visual-graphic systems, such as picture communication symbols or written words, would circumvent the information processing deficits presented by this population. The static feature of nontransient systems, such as pictures or written words, would also allow the individual to rely on recognition rather than recall memory to comprehend language (NRC, 2001). Additionally, the use of nontransient systems enhances the awareness of relevant environmental cues (von Tetzchner, 2001; von Tetzchner et al., 2004). The individual becomes able to check back and forth between the graphic utterance (which represents the relevant cue) and other aspects of the situation during a social interaction. Within a linguistic perspective, static graphic systems may facilitate the establishment of a signifier-significant relationship (von Tetzchner et al., 2004). In this context, it is hypothesized that the use of such systems facilitates the establishment of joint attention and the understanding of shared context.

The picture-based studies published in the last twenty five years have: (a) compared the effects of transient and nontransient systems of communication on the receptive language skills of individuals with ASD (Peterson et al., 1995; Rotholtz et al., 1989; Vaughn & Horner, 1995); (b) combined naturalistic procedures and picture-based systems to promote functional communication (Cafiero, 2001; Hamilton & Snell, 1993; Stiebel, 1999); (c) evaluated the effects of instructional interventions, such as PECS, on the communicative behavior of children with ASD (Bondy & Snell, 1994; Charlop-Christy et al., 2002; Cummings & Williams, 2000; Ganz &
Simpson, 2004; Kravits et al., 2002; Magiati & Howlin, 2003; Schwartz et al., 1998; Tincani, 2004; von Tetzchner et al., 2004); and (d) used picture communication symbols to reduce problem behaviors and increase on-task responses (Bryan & Gast, 2000; Frea et al., 2001; MacDuff et al., 1993; O’Neill & Sweetalnd-Baker, 2001; Schmitt et al., 2000; ).

**Voice Output Devices (VOD)**

Technological development in the field of augmentative and alternative communication has furnished a “voice” to many individuals through voice output communication devices (Schlosser & Blischak, 2001). VOD can be portable AAC mechanical apparatus that produces synthesized (voice produced by a text-to-speech system) or digitized (human voice) speech (NRC, 2001). The activation of the “speech” is done by physically touching graphic symbols (written words, letters, pictures) displayed on the device/switch. Voice output devices (VOD) have been successfully incorporated in research investigations with individuals with autism to increase language and communication skills (Bernard-Opitz, Sriram & Sapuan, 1999; Bernard-Opitz, Ross & Tuttas, 1990; Dyches, 1998; Light, Roberts, Dimarco, Greiner, 1998; Parsons & La Sorte, 1993; Schepis et al., 1998; Sigafoos, Drasgow, Halle, O’Reilly, Seely-York, Edrisinha & Andrews, 2004;).

Using artificial speech rather than visual symbols or sign language permits communication at a larger distance, makes the presence of an interpreter unnecessary and allows the programming of messages of varying lengths (Sevcik & Romski, 1997; von Tetzchner & Martinsen, 2000). Data from studies with adolescents with mental retardation have also suggested that the use of speech output devices contributes to gains in receptive and expressive communication (Romski & Sevcik, 1993, 1996). Prelinguistic communicative behaviors in adolescents with autism have also been successfully substituted by more symbolic communication when voice output devices were introduced (Sigafoos et al., 2004).

Some studies using VOD with individuals with ASD have verified the effects of voice output on the communicative behavior (use of gestures, verbalization, vocalizations, aided system) in the classroom environment (Dyches, 1998; Schepis et al., 1998). Other investigations have used VOD as a component of Computer Assisted Instruction (CAI) to facilitate language and communication development (Bernard-Opiz et al., 1999; Bernard-Opiz et al., 1990; Parsons & La Sorte, 1993) in isolated clinical settings. Still other studies have used VOD in naturalistic settings to replace prelinguistic communication (Sigafoos et al., 2004).
Hybrid Systems

Aided or unaided systems of communication should be adopted considering not only the individual’s cognitive, sensory-motor and language/communication abilities, but also the context of his social interactions. In an AAC intervention it is critical to assess, for instance, with whom, when, where and why individuals need to communicate, as well as identify the strategies used by social partners to interact with the AAC user (Beukelman & Mirenda, 1998; Blackstone & Hunt Berg, 2003; Light et al., 1998; Light & Binger, 1998). In light of the results of this assessment, more than one type of system may be considered appropriate. Light and colleagues (1998), for instance, described a case study where a six-year-old boy with autism utilized various types of communication systems during social interactions. After performing a thorough assessment of the child’s skills and needs as well as identifying important social and environmental variables, three types of augmentative systems of communication (a communication book/dictionary, computer with VOD, conventional gestures) were adopted, since the child was capable to functionally use verbal language. Interestingly, the contexts of the interactions determined the type of system to be utilized. A VOD, for instance, was used to facilitate communication with peers and over the phone, while a communication book facilitated face-to-face interactions. This indicates that the system of communication was chosen considering not only the AAC user’s skills, but also the social partner’s abilities to communicate with the child.

In a related study, Keen, Sigafoos and Woodyat (2001) taught 4 children with autism to replace prelinguistic behaviors with aided and unaided modes of communication. The investigation was held in the participants’ classroom and was conducted by the children’s teachers. As a result of this intervention, the four child participants effectively substituted nonfunctional responses with manual signs, picture systems and vocalizations.

The AAC literature has further emphasized the importance of conducting symbol assessments prior to choosing a symbol system to be incorporated in AAC interventions (Light et al., 1998; Beukelman & Mirenda, 1998). The AAC user’s ability to comprehend the relationship between an object and its referent may be a determining factor when choosing more or less iconic symbols. Kozleski (1991) compared the vocabulary learning rates of individuals with autism exposed to various visual and tactile systems of communication. Using a multiple baseline design, the researcher found that the participants learned how to use Rebus and photopictorical symbols faster than less iconic symbols, such as Blissymbols and orthography.
Participant Characteristics

From the 46 studies analyzed, 42 provided information on individual participant characteristics. Data revealed that the 124 participants (102 males and 22 females) involved in these 42 studies ranged in age from 3 to 21 years. Approximately 30% of these individuals were between ages 3 and 5; 29% between 6 and 8; while 41% of the participants were above age 9. There were no investigations involving children below the age of 3. This is critical, considering that communication intervention has proven to be more effective when provided before the age 3½ (Harris & Handleman, 2000; McGee, Morreier & Daly, 1999). Despite the importance of evaluating how socioeconomic status, race and ethnicity may impact treatment initiatives (NRC, 2001; Parette & Huer, 2002; Parette, Huer & Wyatt, 2002), only five investigations reported the participants’ ethnicity/race (Cafiero, 2001; Charlop-Christy et al., 2002; Ganz & Simpson 2004; Walker et al., 1982; Wherry & Edwards, 1983). From these, 4 individuals were categorized as African-Americans; four as Asians, two as Caucasians, and one as Indian. Only one study (Cafiero, 2001) provided psychosocial measures of the individuals involved.

The assessments of cognitive and sensory perceptual functions (hearing and vision) are crucial in the implementation of AAC interventions (Beukelman & Mirenda, 1998; Kozleski, 1991; Light et al., 1998). These data provide useful information regarding any limitations that might impact channels of input and instruction for potential AAC users. Despite the importance of providing this information, cognitive data was provided for only 79 of the 124 participants described (65%). Likewise, hearing and visual acuity were described for only 31 (25%) participants. From the population analyzed, 63% of the 124 individuals studied were described as having some degree of mental retardation. Eleven participants (8%) were regarded as having normal or superior IQ. Three of the 124 participants had some degree of hearing loss and all subjects whose data was provided were characterized as having normal visual acuity. The deficits described were not reported to affect the optimal use of the communication/language systems adopted.

Individuals with autism may present poor motor imitation skills (Klinger & Dawson, 1992; Smith & Bryson, 1994) and have motor functioning disorders which may impact the use of aided and unaided systems of communication. The incapacity to program movements may cause fine motor problems and the incapacity to adequately learn sign language (Seal & Bonvillian, 1997). Researchers have also reported that children with autism have difficulty in pointing to
objects (Tsai, 1998). This may interfere with the optimal use of AAC systems that require the user to point to pictures on communication boards or to activate a device by holding down a switch in a VOD system. In this context, it becomes essential to assess the motor functioning abilities of this population in order to identify individuals who might successfully use the various types of AAC systems as expressive modes of communication.

In this literature review, researchers from only 6 investigations (Carr et al, 1987; Kouri, 1988; Remington & Clark, 1983; Rotholz et al., 1988; Stiebel, 1999; Walker et al, 1982) provided measures on the participants’ motor skills. In total, 4 of the participants analyzed were regarded as having some degree of motor impairments. In the studies conducted by Carr et al. (1987) and Walker et al. (1982) these deficits did not seem to interfere with the sign language treatment. Rotholz et al. (1989), on the other hand, reported that a communication book was chosen, considering participants’ limitations in using sign language.

The assessment of receptive language/communication skills are essential for identifying when/how the augmentation of spoken language is required as well as identifying alternative forms of language input. Measures of expressive language/communication are crucial to determine how language can be augmented or what type of system would be considered an alternative for persons who are nonverbal. Receptive language data were provided for 66 of the 124 participants; expressive language measures were reported for 103 subjects. Most of the participants analyzed were reported to comprehend simple one-step verbal commands, mainly when accompanied by gestures. In terms of expressive language the majority of the individuals (74%) were characterized as nonverbal or having limited functional verbal skills. Twelve of the 46 studies reviewed reported measures of nonverbal forms of communication (sign language, gestures, vocalizations, and eye-gaze) used by the participants prior to the intervention (Buffington et al., 1998; Cafiero, 2001; Charlop-Christy et al., 2002; Hamilton & Snell, 1993; Keen et al., 2001; Kozleski, 1991; Light et al., 1998; Rotholz et al., 1989; Schmitt et al, 2000; Sigafoos et al., 2004; Stiebel, 1999; Sundberg et al., 2000; von Tetzchner et al., 2004).

**Language Intervention Goals**

Thirty-three (71%) of the 46 studies reviewed focused on teaching communicative/language production skills. Eight investigations (17%) centered in receptive skills and five studies (10%) worked with both receptive and expressive communication. This trend is consistent with general findings from the AAC literature, where a lack of focus on AAC
as an input strategy for individuals with communication and language impairments is reported (Romski & Sevcik, 1993; Roth & Cassatt-James, 1989).

Fourteen studies (14%) focused solely on structural goals, that is, developing discrete skills essential for language development. In these investigations, the following issues were addressed: a) learn initial expressive/receptive vocabulary; b) learn to construct action-object phrases; c) learn to use the AAC system to improve speech articulation; and d) learn to discriminate visual graphic symbols with various degrees of iconicity. Considering that individuals with autism present major deficits in the pragmatic dimension of language (Schuler, 1995), more than half of the studies (63%) aimed at functional goals. In other words, to use sign language, VOD or picture symbols as means of communication. In the studies that aimed at functional goals, the participants were generally taught to use AAC imperatively, while less attention was furnished to the declarative functions of communication. Within this imperative communicative profile, the individuals were usually elicited to respond instead of spontaneously request. Precisely, physical and verbal prompts of varying degrees were used to elicit the learned imperative responses.

Communicative behaviors that did not involve the use of the system or that were not verbal, such as gestures and vocalizations were only measured in a limited number of studies (Charlop-Christy et al., 2002; Ganz & Simpson, 2004; Hamilton & Snell, 1993; Keen et al., 2001; Kouri, 1988; Schepis et al., 1998). This represents a major problem, considering that typically developing children use both linguistic and nonlinguistic utterances to communicate (Paul, 1998). Additionally, the literature has shown that the mode of communication employed by an AAC user is strongly influenced by the communicative function being expressed, the context of the interaction and the social partners involved (Blackstone & Hunt Berg, 2003; Light, Collier & Parnes, 1985; Romski & Sevcik, 1996). Gestures and vocalizations were, for instance, typically employed to make confirmations and denials by nonverbal individuals with physical disabilities in a study conducted by Light and colleagues (1985). These same individuals, on the other hand, were reported to use aided systems to respond to requests.

Investigators have identified differences in the use of aided and unaided systems of communication utilized in interactions involving familiar and unfamiliar social partners. In a survey involving adults with cerebral palsy, Blackstone (1999) found that the participants preferred using speech output devices with unfamiliar people and their limited speech and
gestures with more familiar individuals. Supporting results were found in a similar investigation involving children and young adults with cerebral palsy (age 3-25). In this study, the participants were reported to typically use aided communication devices with unfamiliar people and those who were paid to interact with them (e.g. speech-language pathologists, teachers), while relying more on unaided communication with closer partners, such as family members and friends (Blackstone & Hunt Berg, 2003).

In this context, future investigators should analyze not only the communication conveyed via structured systems, but also unaided and unconventional modes of expression used by AAC users. Moreover, these studies should focus on the types of communicative functions utilized by persons with autism using AAC systems, since most of the data available in the literature come from investigations involving individuals with cerebral palsy or those that present severe physical disabilities.

**Types of Intervention Methods**

Four of the 46 studies analyzed used group designs (Layton, 1988; Magiati & Howlin, 2003; Schwartz et al., 1998; Yoder & Layton, 1988;) while the remaining investigations worked with individual or small group data. Three investigations were descriptive case studies (Bondy & Frost, 1994; Light et al., 1998; Schwartz et al., 1998; von Tetzchner et al., 2004), while the others used some type of experimental research design methodology. From the experimental studies reviewed, 37 used some type of single-subject research methodology (Barlow & Hersen, 1984). This type of approach seemed adequate, considering the heterogeneous characteristics of the population involved and the limited number of participants (Barlow & Hersen, 1984).

Twelve of the 17 sign language studies included teaching strategies derived from traditional behavioral approaches and were mostly held in isolated settings. In general, a single word or phrase was taught receptively or expressively using a multiple trial procedure. This involved the use of repetitive trials applied in a highly structured situation where the experimenter determined the participant’s focus of attention and the sequence of the learning process. The context usually involved the participant and the experimenter and predetermined criteria for correct responses were generally established prior to the treatment. Two sign language studies (Kouri, 1988; Layton, 1988) used more contemporary behavioral procedures (environmental arrangement and following the child’s lead of attention), but also took place in isolated clinical settings. The other investigations (Buffington et al., 1998; Scepis et al., 1982;
Yoder & Layton, 1988) combined contemporary and traditional behavioral procedures. The first was held in a residential facility and the second took place in a semi-structured clinical setting.

Most picture communication studies used the PECS method (Bondy & Frost, 1994; Charlop-Christy et al., 2002; Cummings & Williams, 2000; Frea et al., 2001; Ganz & Simpson, 2004; Kravits et al., 2002; Magiati & Howlin, 2003; Schwartz et al., 1998; Tincani, 2004), which combines traditional behavioral techniques with more contemporary naturalistic strategies (Frost & Bondy, 1994). Combinations of both naturalistic and behavioral approaches were also observed in the studies conducted by Peterson et al. (1995), Rotholz et al. (1989), O’Neill and Sweetland-Baker (2001). Four picture communication studies (Cafiero, 2001; Hamilton & Snell, 1993, Stiebel, 1999; von Tetzchner et al., 2003) used primarily naturalistic teaching procedures to enhance the participants’ communication skills. Sigafoos et al. (1998), Bryan & Gast (2000), Mac Duff et al (1993), Schmit et al. (2000), and Vaughn & Horner (1995) used strategies derived from more traditional behavioral approaches, such as prompting and reinforcement.

Two VOD studies (Dyches, 1989; Schepis et al. 1998) worked within a more naturalistic paradigm. Some of the strategies used by the teachers in the investigation conducted by Schepis et al. (1998), for instance, included: a) child-preferred stimuli, b) child initiated response, c) expectant delays, and d) modeling. Dyches (1989), on the same token, used *coincidental instruction*, a technique which shares similarities with incidental teaching procedures. Two of the CAI studies that utilized VOD used discrete trial procedures (Bernard-Opitz et al., 1990; Sigafoos et al., 2004), the other (Parsons & La Sorte, 1993) primarily used physical prompting and modeling.

The types of intervention methods used in the studies that implemented multiple aided and unaided communication systems varied. Kozleski applied primarily techniques derived from traditional behavioral approaches, such as discrete trial and contingent reinforcement. Keen and colleagues (2001) used functional communication training strategies to replace prelinguistic behaviors. The strategies used by Light and colleagues (1998) were not clearly delineated.

Most studies reviewed in this analysis were experimental investigations and used some type of single subject design methodology. The majority of the sign language studies used primarily discrete trial techniques. Notwithstanding the effectiveness of these strategies in teaching initial repertoire of language forms (Carr et al., 1987; Rogers-Warren & Warren, 1980), this method has been strongly criticized for not promoting generalization of learned behaviors,
leading the learner to become a mere respondent of adult-initiated interactions, and not emphasizing the social uses of language (Quill, 1995). A tendency to combine more naturalistic procedures with behavioral techniques was a characteristic of the picture, VOD, and hybrid investigations. This trend may be explained by the fact that these studies were published in the 90’s, a period in which more naturalistic procedures were in vogue and behavioral procedures were being strongly criticized.

**Settings, Generalization, and Duration**

Seventeen (37%) of the forty-six studies analyzed took place in artificial learning environments, such as therapy rooms or isolated booths in the schools. Seven investigations (15%) combined an artificial setting with a natural environment, such as the participants’ school or home. Sixteen studies (35%) occurred in schools or community settings, two (4%) took place in the children’s homes, while 4 (9%) others combined the school and the home environments. In more than half of the studies (56%), the participants worked solely with the experimenter or a clinician. In thirteen investigations (28%) a teacher or facility staff were the primary interventionists. Only one investigation involved parents as the primary therapists. Five studies combined teachers, parents and experimenters as interventionists. In one study the main interventionist was unclear.

Less than half of the studies (48%) reported clear generalization or maintenance measures. Many of the skills learned in the treatment settings, however, were assessed in similar structured environments or with other adults using identical procedures to prompt the learned behaviors. Very few investigations documented changes in at least one natural environment outside the treatment setting. Therefore, the “true” generalization results of the majority of these studies are highly questionable.

The duration of the studies analyzed in this review varied considerably. Twenty-six investigations reported the length of interventions in terms of number of sessions, without consistently specifying their length or overall duration. These varied from 4 to 200 encounters. Two (8%) of these 26 interventions occurred in ten sessions or less; ten (38%) lasted from 11 to 32 sessions; seven (27%) from 33 to 70 encounters and the other seven (27%) interventions had a duration superior to 71 sessions. Eleven studies reported their duration in terms of months or years. One (9%) study lasted for 3 months; seven studies (64%) had duration between 6 and 12 months, while three investigations (27%) lasted between 22 and 48 months. One study failed to
provide the duration of the intervention. The three remaining investigations reported that the sessions occurred from 4 to 5 days per week, lasted from 20 to 45 minutes and that the participants required from 15 to 1000 trials to learn the predetermined skills.

Reliability Measures and Social Validation

Three of the forty-six studies analyzed in this report failed to provide reliability measures of the dependent variables. Most of these investigations used multiple independent observers that generally reached reliability rates not inferior to 80%. Only eleven investigations (24%) reported measures of social validity. In eight of these studies a questionnaire was used to assess the level of satisfaction with the interventions. The respondents reported positive perceptions of the treatments applied in both studies.

The lack of social validation measures of many of these studies as well as the noninvolvement of caregivers, teachers or other significant social partners in the interventions is critical. As suggested in the research literature, communication partners play a critical role in supporting the communication efforts of individuals who are learning to speak using aided and unaided systems of communication (Angelo, Jones & Kokoska, 1995; Berry, 1997; Blackstone & Hunt Berg, 2003; Parette & Angelo, 1996; Udwin & Yule, 1991). The sustainability of an AAC system strongly depends on the child and family’s characteristics and, precisely, the family’s acceptance in using the system. One of the best predictors of parental attitude towards the use of AAC systems in a study involving children with cerebral palsy (age 3-9) was the number of siblings the child had (Udwin & Yule, 1991). In this study, the investigators found that parents of larger families tended to view the use of the systems less favorably than smaller families. Additionally, these same investigators revealed that caregivers of children who experienced physical and behavioral difficulties were less likely to incorporate the use AAC in the home environment. Family concerns, such as the fear that the system will inhibit speech development should also be addressed. Parents are unlikely to encourage their children to use aided and unaided systems of communication if they are not convinced of its effectiveness (Udwin & Yule, 1991). These findings suggest that family values, routines, needs and resources must be considered when introducing AAC systems of communication to children with language/communication deficits, such as those with ASD.
Effects of Intervention

The four types of AAC communication strategies described in this review seemed to be effective for individuals with ASD that presented some degree of mental retardation and were, in general, above the age of 3. In spite of the diverse theoretical frameworks of the 46 studies analyzed, their varying duration, the different intervention goals established and the heterogeneous characteristics of the participants involved, many interesting conclusions were evidenced. In the total communication/sign language studies, the following results were encountered: (a) sign language and total communication are more effective for teaching receptive and expressive vocabulary than speech alone methods, precisely for poor verbal imitators; (b) sign language can function as a mediating system for speech; (c) good verbal imitators are better at comprehending speech than poor verbal imitators, despite performing equivalently in sign discrimination tasks; (d) good verbal imitators attend to the binary components of total communication, while poor verbal imitators tend to perceive only the sign component; (e) behavioral strategies alone or combined with more naturalistic teaching strategies can be effective for teaching expressive and receptive sign language and speech; (f) children with autism can be taught to produce multi-sign utterances using behavioral strategies; (g) the language developmental patterns of individuals with autism exposed to sign language may differ from those of typically developing children; (h) expressive sign language can be best incited through intraverbal prompts than through generalized verbal prompts.

In the investigations that used visual-symbols as AAC strategies, the following results were found: (a) individuals with autism respond better to nontransient forms of communicative input (e.g. pictures) than more transient forms (sign language and speech); (b) PECS can enhance language production of children with autism; (c) naturalistic teaching strategies can enhance the use of communication book use; (d) the frequency in the use of nonverbal communication strategies (e.g. gestures, vocalizations) in individuals with autism vary when picture-based systems of communication are implemented; (e) the use of visual schedules can successfully diminish disruptive behaviors; and (f) parents can be successfully taught as language intervention agents to conduct AAC treatments.

In the studies involving voice output systems the following findings were highlighted: (a) VOD use may be successfully taught to preschoolers and school aged children using naturalistic teaching strategies; (b) preschool teachers may be successfully trained to apply naturalistic
instructional strategies with students with autism when teaching them to use VODs; (c) the frequency of communicative interactions of some children with autism may increase when they are taught to use VODs communicatively with their teachers; (d) the use of these devices with this population is not reported to facilitate interactions with peers; (e) VOD use may enhance the production of other modes of communication such as verbalizations, gestures and vocalizations; (f) the mean length of utterances produced by individuals with autism increase with the use of VODs; and (g) computer assisted instructions that incorporate VOD may enhance verbal communication of individuals with autism.

The hybrid studies showed that: (a) the assessment of the individual’s sensory-motor, cognitive and language/communication skills are imperative when implementing AAC interventions; (b) individuals with autism learn to use more iconic symbols, such as pictures and Rebus symbols, faster than less iconic symbols; (c) the development of communication competency depended on the appropriate assessment of social and environmental variables; (d) aided and unaided systems of communication can be effectively used to replace prelinguistic behaviors in children with ASD; and (e) more than one communication system might be required when considering the diverse settings in which the individual typically interacts.

Not much can be empirically stated regarding the advantages of one system over another, since only two studies (Rotholz et al., 1988; Tincani, 2004) compared the effectiveness of different AAC systems. Nonetheless, many investigators in this review anecdotally discussed the benefits of each system. Some of the advantages of using sign language included (a) its “portability”; (b) its characteristic of being a true language system and (c) the possibility of communication occurring at a faster pace. Among the positive aspects of using a picture-based system were: (a) its iconicity; (b) its nontransient nature; and (c) the limited motor requirements for its use. VODs were considered advantageous for (a) they allowed communication to occur at larger distances; (b) they permitted messages to be easily deciphered; and (c) required limited cognitive and motor demands.

Both traditional behavioral strategies and more naturalistic approaches seemed to be effective for teaching the use of AAC systems to individuals with autism. None of the studies compared the effectiveness of one method over another. Researchers tended to use more traditional and highly controlled behavioral techniques in individuals with limited communication repertoire than those who presented more advanced language/communication
skills. This is comprehensible, in view of the fact that traditional behavioral approaches have been reported successful at installing behaviors and more naturalistic methods at promoting the generalization of existing repertoire of responses (Carr et al., 1987; Rogers-Warren & Warren, 1983). Participants who had been previously exposed to alternative communication systems prior to the intervention were generally trained using more naturalistic contexts, whereas those with restricted skills in more artificial scenarios. Another interesting finding was that most recent studies – particularly the ones dating from the 90’s - opted for using hybrid approaches. In general, these experiments initiated in self-contained environments where an experimenter usually used an operant teaching model involving techniques such as prompting, fading, or differential reinforcement, and gradually moved towards a more naturalistic setting, where strategies such as environmental arrangement and following the child’s lead of attention were applied.
Table 1.1

**AAC Systems in Individuals with Autism: Total Communication/Sign language Studies Analyzed**

<table>
<thead>
<tr>
<th>Author</th>
<th>Participants</th>
<th>Design</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Duration</th>
<th>General findings</th>
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<tbody>
<tr>
<td>Barrera &amp; Sulzer-Azaroff, 1983</td>
<td>3 females CA: 6-9</td>
<td>Alternating treatment: TC and SA</td>
<td>Modeling, chaining, stimulus-fading Conditions: TC and SA</td>
<td>Expressive sign and speech</td>
<td>16-25 sessions</td>
<td>- Number of words learned/ condition: P1: – TC: 5 words; SA:1 words/ ;P2: - TC:8 words; SA:1 words; P3: - TC: 10 words; SA: 0 words; TC superior to SA; - Generalization/maintenance measures not addressed (IV) - No social validation data provided</td>
</tr>
<tr>
<td>Barrera, Lobato-Barrera &amp; Sulzer-Azaroff, 1980</td>
<td>1 male CA: 4</td>
<td>Alternating treatment: TC, SL and SA conditions</td>
<td>Modeling, chaining, stimulus-fading Conditions: TC, SL and SA</td>
<td>Expressive sign and speech</td>
<td>12 sessions</td>
<td>- Number of words learned/ phase: Phase III: TC: 10 words (12 days); SA and SL : 4 words (12 days); Phase IV: TC: 11 words (3 days) - TC superior to SA and SL - Generalized to other experimenters and settings (II) - No social validation data provided</td>
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Table 1.1 Continued

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<th>Author</th>
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<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Duration</th>
<th>General findings</th>
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<tr>
<td>Buffington, Krantz,</td>
<td>4 males and 1</td>
<td>Multiple baseline across response design</td>
<td>Modeling, reinforcement, verbal praise, physical prompt</td>
<td>Expressive use of gestures and verbalizations</td>
<td>~ 65 – 70 sessions</td>
<td>- All participants increased learned to use gestural and verbal responses in training sessions and generalization probes; - Generalization in different setting with novel stimuli (I); Social validity assessed</td>
</tr>
<tr>
<td>McClannahan &amp; Poulson, 1998</td>
<td>CA: 4 - 6</td>
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<tr>
<td>Carr &amp; Kologinsky, 1983</td>
<td>Study 1: 3 males CA: 9-14</td>
<td>Study 1: Multiple baseline across subjects</td>
<td>Prompting, fading, differential reinforcement,</td>
<td>Expressive sign</td>
<td>26-48 sessions</td>
<td>- Study 1: P1, P2 and P3 – increased frequency of spontaneous sign; - Study 2: P4, P5 and P6 – spontaneous signing (to request 2 objects) generalized across settings; Reduction of self-stimulation - Generalized to other experimenters and settings (II); - No social validation data provided</td>
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<tr>
<td></td>
<td>Study 2: 3</td>
<td>Study 2: Reversal design (ABCBCD):</td>
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<th>Duration</th>
<th>General findings</th>
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</thead>
<tbody>
<tr>
<td>Carr &amp; Dores, 1981</td>
<td>6 males CA: 6-11</td>
<td>Multiple baseline settings and subjects</td>
<td>Prompting, stimulus rotation, differential reinforcement.</td>
<td>Receptive (comprehension) of sign and speech</td>
<td>Duration: 30 m</td>
<td>- Average of 97-286 trials to criterion to learn 6 sets of 4 objects (24 words in total) - Good verbal imitators acquired receptive sign + speech; - Poor verbal imitators acquired receptive sign; - Generalization/maintenance not addressed (IV); - No social validation data provided</td>
</tr>
<tr>
<td>Carr, Kologinsky &amp; Leff-Simon, 1987</td>
<td>4 males CA: 11-16</td>
<td>Multiple baseline response, (across stimulus rotation, phrases)</td>
<td>Prompt, fading, differential reinforcement, child initiated response, (construction of action-object phrases)</td>
<td>Expressive sign language of sign and speech</td>
<td>Duration: 18-26 sessions</td>
<td>- Words taught: 15 action-object items – 3 verbs and 15 nouns (45 combinations) - 1,208-11,155 trials required to produce generalized responding across 3 action-object phrases. - Generalized to similar verbal structures (II) - No social validation data provided</td>
</tr>
<tr>
<td>Author</td>
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<td>Independent Variables</td>
<td>Dependent Variables</td>
<td>Duration</td>
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<tr>
<td>Carr, Pridal</td>
<td>8 males and 2 females</td>
<td>Compare good and poor verbal imitators</td>
<td>Prompting, differential reinforcement.</td>
<td>Duration: 4 days</td>
<td>3 pairs of objects: ~15-300 trials to reach sign criterion; ~ 15-1000 trials to reach speech criterion</td>
<td></td>
</tr>
<tr>
<td>&amp; Dores, 1984</td>
<td>CA: 6-16</td>
<td>Conditions: Sign language and speech alone</td>
<td>Receptive (comprehension) sign and speech</td>
<td>Freq.: 4 days</td>
<td>- Good = poor verbal imitators in sign discrimination; - Good&gt;poor verbal imitators in speech discrimination</td>
<td></td>
</tr>
<tr>
<td>Ferrarese &amp;</td>
<td>1 male</td>
<td>Compare speech articulation using SL and without using</td>
<td>Expressive speech articulation and sign language use</td>
<td>Duration: 6 months</td>
<td>Improved the articulation of 79 words in the SL condition</td>
<td></td>
</tr>
<tr>
<td>Norton, 1982</td>
<td>CA: 8.5</td>
<td>Prompting and fading</td>
<td></td>
<td></td>
<td>- Motor movement of hand sign may improve motor planning for the articulation of words</td>
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<td>- Generalization/maintenance not addressed (IV)</td>
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<td>- No social validation data provided</td>
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<td>Dependent Variables</td>
<td>Duration</td>
<td>General findings</td>
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<tr>
<td>Kouri, 1988</td>
<td>1 male</td>
<td>ABA</td>
<td>Environmental arrangement, following child’s lead of attention, modeling.</td>
<td>Expressive communication (verbal, eye-contact, SL and gestures)</td>
<td>~ 8 months</td>
<td>- Increased use of eye contact, verbalizations and gestures.</td>
</tr>
<tr>
<td></td>
<td>CA: 3</td>
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<td>- Decrease in the use of sign language</td>
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<td>- Generalization/maintenance not addressed (IV)</td>
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<td></td>
<td></td>
<td>- No social validation data provided</td>
</tr>
<tr>
<td>Layton, 1988</td>
<td>49 males and 11 females</td>
<td>Random assignment</td>
<td>Discrete-trial Shaping, fading SL, SA, TC + alternating treatment SL and SA</td>
<td>Expressive and receptive sign and speech</td>
<td>90 sessions</td>
<td>High verbal imitators performed equally well in the four conditions; Poor verbal imitators performed the poorest in the SA condition; - Generalization across settings and persons; Maintenance – words retained 3 months after treatment (II);- No social validation data provided</td>
</tr>
</tbody>
</table>
Table 1.1 Continued

<table>
<thead>
<tr>
<th>Author</th>
<th>Participants</th>
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<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Duration</th>
<th>General findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remington &amp; Clark, 1983</td>
<td>1 male and 1 female CA: 10 and 15 (TC and SL)</td>
<td>Alternating treatment across conditions</td>
<td>Modeling, prompting (sign language)</td>
<td>Expressive SL</td>
<td>13-17 sessions</td>
<td>Signs acquired: 5; TC = SL in speed of acquisition of expressive signing; TC – stimulates the acquisition of receptive speech of good verbal imitators; no affect on poor verbal imitators. Maintenance - 4 weeks after termination of treatment (II); - No social validation data provided</td>
</tr>
<tr>
<td>Schepis, Reid, Fitzgerald, Faw, Den Pol &amp; Welty, 1982</td>
<td>4 males CA: 7-11 participants</td>
<td>Multiple baseline across time of day and teaching.</td>
<td>Prompting, environmental arrangement, incidental teaching.</td>
<td>Expressive SL</td>
<td>~30 sessions</td>
<td>Signs acquired: 17 signs; - TC + behavioral and naturalistic teaching techniques effective at enhancing sign language use; - Signing increased for good and poor verbal imitators; - Vocalizations increased for good verbal imitators; - Generalized across staff and settings (II) - Social validation assessed</td>
</tr>
<tr>
<td>Author</td>
<td>Participants</td>
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<td>Dependent Variables</td>
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<tr>
<td>Sundberg,</td>
<td>2 males</td>
<td>Within subject</td>
<td>2 types of verbal</td>
<td>Expressive SL</td>
<td>50-60</td>
<td>Participants learned to use expressive sign for 6 objects; Specific intraverbal prompt more effective at promoting SL than general verbal prompt</td>
</tr>
<tr>
<td>Endicott &amp;</td>
<td>CA: 4 and 5</td>
<td>replication</td>
<td>intraverbal</td>
<td></td>
<td></td>
<td>Maintenance (anecdotally reported) (IV)</td>
</tr>
<tr>
<td>Eigenheer, 2000</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>No social validation data provided</td>
</tr>
<tr>
<td>Walker, Hinerman,</td>
<td>1 male</td>
<td>Single-subject</td>
<td>Modeling, overcorrection</td>
<td>Expressive SL and speech</td>
<td>3 months</td>
<td>P learned sign + speech of 8 objects. Overcorrection + TC – more effective at promoting expressive sign and speech than overcorrection alone or overcorrection + modeling</td>
</tr>
<tr>
<td>Jenson &amp; Peterson, 1982</td>
<td>CA: 5</td>
<td>reversal</td>
<td>Condition: TC</td>
<td></td>
<td></td>
<td>Use of sign language as a mediating system to speech; Generalized to 4 objects in other settings (II); No social validation data provided</td>
</tr>
</tbody>
</table>
Table 1.1 Continued

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<thead>
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<tbody>
<tr>
<td>Watters, Wheeler &amp;</td>
<td>2 males and 2</td>
<td>Within subject</td>
<td>Condition 1: TC</td>
<td>Expressive</td>
<td></td>
<td>- 8 words learned</td>
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<tr>
<td>Watters, 1981</td>
<td>females CA: 10-16</td>
<td>comparison between 2 TC conditions</td>
<td>expressive 1&lt;sup&gt;st&lt;/sup&gt; – receptive 2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>and receptive sign</td>
<td>6-9 months</td>
<td>- Contradiction to Chomsky’s theory – participants had better results in Condition 1 than in Condition 2.</td>
</tr>
<tr>
<td>Wherry &amp; Edwards, 1983</td>
<td>1 male CA: 5</td>
<td>Simultaneous treatment</td>
<td>Prompting, differential reinforcement.</td>
<td>Receptive sign and speech</td>
<td>18 days</td>
<td>- 27 words learned</td>
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<td></td>
<td></td>
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<td>Condition 2: TC</td>
<td>Expressive</td>
<td></td>
<td>- TC=SA=SL at promoting receptive sign and speech in a child who was nonverbal</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>receptive 1&lt;sup&gt;st&lt;/sup&gt; – expressive 2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>language</td>
<td></td>
<td>- Generalization/maintenance not addressed (IV)</td>
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<th>General findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yoder &amp; Layton,</td>
<td>60 children</td>
<td>Random</td>
<td>SA, SL, TC,</td>
<td>Expressive: speech</td>
<td>90</td>
<td>- Training that included verbal input were superior to the SL in facilitating child-initiated use of spoken words;</td>
</tr>
<tr>
<td>1988 CA: ~ 5)</td>
<td>assignment</td>
<td>alternating SL and SA</td>
<td>speech sessions</td>
<td>90</td>
<td></td>
<td>- Poor verbal imitators fail to process speech in favor of sign; - Low verbal imitators use fewer words than good imitators;</td>
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<td></td>
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<td></td>
<td>- Generalization across settings (I)</td>
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<td></td>
<td>- No social validation data provided</td>
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</table>

Note: TC = Total communication; SL = Sign language; SA = Speech alone; P = participant; bl = baseline; t = treatment; freq. = frequency; m = minutes; ~ = approximate value; CA: chronological age (years); Generalization/ Maintenance: I. Documented changes in at least one natural setting outside of treatment setting; II. Generalization to one other setting/skill/partner or maintenance beyond experimental intervention in natural setting in which intervention took place; III. Intervention occurred in natural setting or use of outcome measures with documented relationship to functional outcome; IV Not addressed or other (adapted from NRC, 2001)
Table 1.2

**AAC Systems in Individuals with Autism: Communication Systems that Use Visual Graphic Symbols**

<table>
<thead>
<tr>
<th>Author</th>
<th>Participants</th>
<th>Design</th>
<th>Independent Variables</th>
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<th>Duration</th>
<th>General findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bondy &amp; Frost, 1994</td>
<td>1 male CA: 3</td>
<td>Descriptive case study</td>
<td>PECS</td>
<td>Expressive (speech and picture communication cards)</td>
<td>11 months</td>
<td>- 1 month: request 8 items using 1 symbol; 2 months: combine 2 symbols; 3 / 4 months: respond to verbal questions; 5 months: speech + picture symbols; 11 months: only speech; Generalization/maintenance not addressed/ unclear (IV); No social validation data</td>
</tr>
<tr>
<td>Bryan &amp; Gast, 2000</td>
<td>3 males and 1 female CA: 7 to 8</td>
<td>Single subject A-B-A-B withdrawal design</td>
<td>Graduate guidance procedure + Picture activity schedule</td>
<td>Receptive comprehension of activity schedule + on task behavior</td>
<td>~ 35 sessions</td>
<td>- Graduated guidance procedure was effective at teaching students to stay on task; - Participants maintained high levels of independent on-task and on-schedule behaviors with the use of AAC - Generalization assessed to novel activity (I) - Social validity questionnaire to school staff</td>
</tr>
<tr>
<td>Author</td>
<td>Participants</td>
<td>Design</td>
<td>Independent Variables</td>
<td>Dependent Variables</td>
<td>Duration</td>
<td>General findings</td>
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<tr>
<td>Charlop-Christy, Carpenter, Le, LeBlanc, and Kellet, 2002</td>
<td>3 males, CA: 3-12</td>
<td>Multiple baseline across participants</td>
<td>PECS</td>
<td>Expressive AAC, vocal, social communication + problem behavior</td>
<td>~ 170 minutes; ~ 246 total trials (14 – 23 sessions)</td>
<td>- All participants increased frequency of requests, initiations, and verbalizations Decrease in problem behaviors Generalization data provided (II) No social validation data provided</td>
</tr>
<tr>
<td>Cafiero, 2001</td>
<td>1 male, CA: 13</td>
<td>A-B (baseline-treatment)</td>
<td>Communication board</td>
<td>Expressive (picture) and receptive speech + picture + problem behavior (out-of-seat)</td>
<td>22 months</td>
<td>- Receptive vocabulary increased from 16 to 67 symbols- Expressive vocabulary: a) # of picture symbols – increased from 4 to 29 words; b) Ability to form multi-symbol utterances (2 –3 words); c) Functions: comment, request - Decreased frequency of inappropriate behavior Generalization/maintenance not addressed - No social validation data provided</td>
</tr>
</tbody>
</table>
Table 1.2 Continued

<table>
<thead>
<tr>
<th>Author</th>
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<th>Duration</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Cummings &amp; Williams (2000)</td>
<td>5 males CA: 3-5</td>
<td>Single subject A-B-C design</td>
<td>Discrete trial + PECS + Vocal imitation training</td>
<td>Expressive (picture and vocalization)</td>
<td>~ 56 – 200 sessions</td>
<td>- All participants learned to match objects to pictures; then pictures to pictures; 4 participants learned to use PECS. - After mastering PECS, the 4 participants learned to verbally imitate. - No social validity data provided. - Generalization not assessed (IV).</td>
</tr>
<tr>
<td>Frea, Arnold &amp; Vittimberg a, 2001</td>
<td>1 male CA: 4</td>
<td>Multiple baseline across setting</td>
<td>PECS</td>
<td>Expressive: picture use and aggressive behavior</td>
<td>~ 40 days</td>
<td>- Participant reduced aggressive behavior and increased picture use; - The introduction of the picture system increased the participant’s ability to exert choice and control in play activities. - No social validity data provided. - Generalization not assessed (IV).</td>
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Table 1.2 Continued

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Ganz &amp; Simpson</td>
<td>1 female, 8; 2 males</td>
<td>Single subject within subjects (changing criterion)</td>
<td>PECS</td>
<td>Expressive</td>
<td>19-29</td>
<td>- Increase verbalizations (varied among participants); Increase expressive AAC use</td>
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<td></td>
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<td></td>
<td></td>
<td>(picture), verbalizations and non word vocalization</td>
<td>sessions</td>
<td>- No clear relation between changes in spoken words and non-word vocalizations. 1</td>
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<td>participant increased non-word, the other maintained stable, 3rd decrease; No social validity data provided; - Generalization across persons (anecdotally reported) IV</td>
</tr>
<tr>
<td>Hamilton &amp; Snell, 1993</td>
<td>1 male, autism + Mental Retardation</td>
<td>Changing-criterion design within a multiple probe across settings</td>
<td>Expectant look (time delay) + Mand; Model + Question</td>
<td>Communication</td>
<td>160</td>
<td>- Before intervention: use of 8 symbols; after intervention: 79 symbols; Decrease of nonsymbolic communication; Use of phrases w/ 3 or more words; Social validation assessed - Generalized across settings/ persons; Maintenance after 1 year (I)</td>
</tr>
<tr>
<td>Author</td>
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<td>Duration</td>
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<tr>
<td>Kravits, Kamps,</td>
<td>1 female</td>
<td>Multiple baseline across settings</td>
<td>PECS + Social skills training</td>
<td>Expressive (speech, symbols and signs)</td>
<td>7 months</td>
<td>PECS condition: Frequency of initiations increased from –to: Home: 0 -10; center (school): 0-6; journal (school) 10-14; Social skills did not seem to affect the frequency of response; No social validity data provided; Generalized across settings/ persons (II)</td>
</tr>
<tr>
<td>Kemmerer &amp; Potucek, 2002</td>
<td>CA: 6</td>
<td>Multiple baseline across settings</td>
<td>PECs + Social skills training</td>
<td>Expressive (speech, symbols and signs)</td>
<td>7 months</td>
<td>PECS condition: Frequency of initiations increased from –to: Home: 0 -10; center (school): 0-6; journal (school) 10-14; Social skills did not seem to affect the frequency of response; No social validity data provided; Generalized across settings/ persons (II)</td>
</tr>
<tr>
<td>MacDuff, Krantz &amp; McClanna, 1993</td>
<td>4 males</td>
<td>Multiple baseline across participants</td>
<td>Teaching package: Graduate guidance procedure + Picture activity schedule</td>
<td>Receptive comprehension of activity</td>
<td>~ 108 sessions</td>
<td>- Graduated guidance procedure was effective at teaching students to stay on task; No social validity data provided; Generalization assessed to novel activity (I)</td>
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</thead>
</table>
| Magiati & Howlin, 2003 | 29 males; 5 females | CA: 5 -12 | Pre and post training evaluation | PECS – teacher training | Expressive picture, sign and verbalizations | 6 months | - Increase in average PECS use over 2 month period;  
- Increase in vocabulary use (PECS)  
- Small increase in the average frequency of words and sign language;  
- Social validity of some parents and teachers  
- Generalization anecdotally reported (IV) |
| O’Neill & Sweetland-Baker, 2001 | 2 males (age 6 and 15) | Alternating treatment design | Functional Communication Training | Expressive communication + Disruptive behaviors | ~ 35 – 70 sessions | - Increase in participants’ request for “break” using picture card  
- Decrease in disruptive behavior following treatment  
- No social validity data provided  
- Generalization accessed in untrained routines (I) |
<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Peterson, Bondy,</td>
<td>2 males</td>
<td>A-AB-B design</td>
<td>A: speech; B: pictures/gesture</td>
<td>Prompting using speech, pictograms and gestures</td>
<td>Duration: ?</td>
<td>- % of correct response in object retrieval task: Year 1: P1: 10% (condition A); 100% (AB and B); P2: ~15% (A); 90% (AB and B); Year 2: P1: ~15% (A); 70% (AB and B); - Self-injurious + disruptive behaviors decreased in AB and B; - Generalization/maintenance not addressed (IV); - No social validation data</td>
</tr>
<tr>
<td>Vincent &amp; Finnegan,</td>
<td>CA: 7 and 9</td>
<td>AB: speech + pictures/gesture</td>
<td>Prompting speech and gestures</td>
<td>Receptive speech and picture comprehension</td>
<td>Duration: ?</td>
<td>- Mean percentage of successful requests at restaurant; A-B-A-B conditions: P 1: 0% - 95%-0%-100%; P 2: 0% -100% - 25% - 100%; Community members better comprehension of picture book when compared to sign language use; - Generalized across persons and setting (I); - No social validation data provided</td>
</tr>
<tr>
<td>Rotholz, Berkowitz &amp; Burberry,</td>
<td>2 males</td>
<td>ABAB reversal and multiple baseline across participants</td>
<td>Progressive use of communication Book and signing</td>
<td>Duration: ?</td>
<td>29 probe sessions</td>
<td></td>
</tr>
<tr>
<td>Author</td>
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<tr>
<td>Schmit, Alper,</td>
<td>1 male</td>
<td>Multiple baseline across setting</td>
<td>Prompting using speech and pictograms</td>
<td>Receptive: speech and picture + Tantrums</td>
<td>39 days</td>
<td>- The use of photographic cueing + verbal cue were effective at reducing tantrums; - Participants increased time spent in other learning activities</td>
</tr>
<tr>
<td>Raschke, 2000</td>
<td>CA: 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Participant gained greater level of independence; - No social validation data provided - Generalization not assessed (IV)</td>
</tr>
<tr>
<td>Shwartz, Garfinkle &amp; Bauer, 1998</td>
<td>Study 1 – 16 children (gender?)</td>
<td>Descriptive data of the effects of treatment</td>
<td>PECS</td>
<td>Expressive communication picture, communication cards</td>
<td>12 months</td>
<td>- Mastery of phases of PECS (*): Phase 1 – 1-5 months; Phase 2 – 1-6 months; Phase 3 – 1-6 months; Phase 4 – 1-9 months; Phase 5 – 1-12 months</td>
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</tbody>
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</thead>
<tbody>
<tr>
<td>Shwartz,</td>
<td>Study 2 – 11 males</td>
<td>Discrete trial (prompting, reinforcement, hand-guidance)</td>
<td>PECS (phases): 1. Exchange; 2. Distance/persistence; 3. Discrimination</td>
<td>a. Expressive (speech)</td>
<td>12 months</td>
<td>- % of communicative functions of each child varied; Participants who had training in one communicative function (request, protest, comment and response) demonstrated increased use of other untrained functions. 6 participants developed functional speech; 5 children continued using only PECS as primary mean of communication. - No social validation data - Generalization anecdotally reported (IV)</td>
</tr>
<tr>
<td>Garfinkle &amp; Bauer, 1998</td>
<td>Study 1 CA: 3-5</td>
<td>PECS in speech acquisition of talkers and nontalkers</td>
<td>PECS (phases): 1. Exchange; 2. Distance/persistence; 3. Discrimination</td>
<td>b. Expressive gesture, vocalization, signs, cards, speech</td>
<td>12 months</td>
<td></td>
</tr>
<tr>
<td>Sigafoos, 1998</td>
<td>1 male CA: 6</td>
<td>Discrete trial (prompting, reinforcement, hand-guidance)</td>
<td>Expressive card use (WANT)</td>
<td>38 sessions</td>
<td>- Participant learned to use the card for request - Overgeneralization of requesting (request items with no need); No social validation data; Generalization not assessed (IV)</td>
<td></td>
</tr>
</tbody>
</table>
Table 1.2 Continued

<table>
<thead>
<tr>
<th>Author</th>
<th>Participants</th>
<th>Design</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Duration</th>
<th>General findings</th>
</tr>
</thead>
</table>
| Stiebel    | 3 males      | Multiple baseline across child and parent behavior | Natural Language Paradigm – Parent training program | Expressive card use | ~ 21-26 sessions (6 months) | - Parents learned to apply the teaching strategies  
- Children increased card use  
- Social validity assessed  
- Generalization in nontrained routines (I) |
| (1999)     | CA: 4-6      |                            |                       |                     |          |                                                       |
| Tincani    | 1 male and 1 female | Alternating treatment Comparison: | Expressive sign and card use (for requesting) | PECS | ~ 30 sessions | - Sign language was more effective for teaching requesting to one participant; the other learned better using PECS ; - Sign language training produced more word vocalization than PECS training; - Mands learned with trainer were generalized to classroom teacher.  
- Social validity provided by parent and teacher questionnaire; - Generalization reported (II) |
| (2004)     | CA: 5 and 6  | Sign language and PECS  | PECS                 |                     |          |                                                       |
Table 1.2 Continued

<table>
<thead>
<tr>
<th>Author</th>
<th>Participants</th>
<th>Design</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Duration</th>
<th>General findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaughn &amp; Horner, 1995</td>
<td>1 male</td>
<td>ABA'B</td>
<td>verbal; B: speech and</td>
<td>Prompting using</td>
<td>117</td>
<td>- Higher percentage of meal acceptance when picture alone or combined with speech was used as input method; Decrease in disruptive behavior; Maintenance after 1 year (II) - No social validation data</td>
</tr>
<tr>
<td></td>
<td>CA: 21</td>
<td>design A: verbal; B: speech and pictograms</td>
<td>Receptive speech + picture system + behavior</td>
<td>sessions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vonTetzchner, Øvreeide, Jørgensen, Oxholm, Ormhaug, Warme, 2004</td>
<td>1 female</td>
<td>Case</td>
<td>Total communication; “Communicative problem strategy”</td>
<td>Expressive and receptive communication</td>
<td>4 years</td>
<td>- Participant learned to use pictograms and photographs to communicate - No progress in signing or using speech - No social validation data provided - Generalization not assessed (IV)</td>
</tr>
<tr>
<td></td>
<td>CA: 4</td>
<td>study</td>
<td></td>
<td></td>
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</tbody>
</table>

Note: PECS: Picture Exchange Communication System; ~ : approximate value; CA: chronological age (*) Include the scores of participants with other developmental disorders; Generalization/Maintenance: I. Documented changes in at least one natural setting outside of treatment setting. II. Generalization to one other setting/skill/partner or maintenance beyond experimental intervention in natural setting in which intervention took place; III. Intervention occurred in natural setting or use of outcome measures with documented relationship to functional outcome; IV Not addressed or other (adapted from NRC, 2001)
### Table 1.3

**AAC Systems in Individuals with Autism: Communication Systems that Use Voice Output Devices**

<table>
<thead>
<tr>
<th>Author</th>
<th>Participants</th>
<th>Design</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Duration</th>
<th>General findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bernard -Opiz, Sriram, Sapuan, 1999</td>
<td>9 males and 1 female CA: 3-7</td>
<td>Simultaneous treatment design</td>
<td>Comparison: CAI and PI</td>
<td>Frequency of imitative vocal response</td>
<td>10 sessions</td>
<td>Participants showed greater vocal imitation in CAI condition than when interacting with a parent or a trainer; No significant difference between trainer and parent; Social validity data provided; Generalization not provided (IV);</td>
</tr>
<tr>
<td>Dyches (1998)</td>
<td>2 males CA: 10 and 11</td>
<td>Single-subject withdrawal (A-B-A-B)</td>
<td>Coincidental instruction 2 conditions: With switch and without use of switch</td>
<td>Expressive use of VOD and verbalization</td>
<td>~ 50 days</td>
<td>- Frequency of communicative interactions and verbalizations greater in switch condition for all participants - No social validation data provided - Generalization/maintenance not provided. (IV);</td>
</tr>
</tbody>
</table>
Table 1.3 Continued

<table>
<thead>
<tr>
<th>Author</th>
<th>Participants</th>
<th>Design</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Duration</th>
<th>General findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parsons &amp; La Sorte, 1993</td>
<td>5 males and 1 female</td>
<td>A-B-BC-B-BC Design A: baseline; B: computer; BC: computer</td>
<td>CAI with 2 conditions: 1) VOD on 2) VOD off</td>
<td>Expressive communication: verbal utterances</td>
<td>10 weeks</td>
<td>- Frequency of verbalizations increased for all participants in computer condition; - CAI with VOD increases the frequency of spontaneous utterances of some children; Generalization/maintenance not provided (IV); - No social validation data provided</td>
</tr>
<tr>
<td>Schepis, Reid, Behrmann, and Sutton (1998)</td>
<td>3 males and 1 female</td>
<td>Multiple-probe design across 2 participants in 2 routines and 2 participants in one routine</td>
<td>Expressive use of VOCA + gestures + vocalizations + verbalizations</td>
<td>~ 35 sessions</td>
<td>14 months later (II)</td>
<td>- Gestures + nonword vocalization increased; - Frequency of communicative interactions increased with teachers; Device did not facilitate communicative interactions among peers; The participants used the VOD consistently without a specific verbal prompt to communicate; - Maintenance data 2, 4, 12 and 14 months later (II)</td>
</tr>
<tr>
<td>Author</td>
<td>Participants</td>
<td>Design</td>
<td>Independent Variables</td>
<td>Dependent Variables</td>
<td>Duration</td>
<td>General findings</td>
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<tr>
<td>Sigafoos, Drasgow, Halle, O’Reilly, Seely-York &amp; Edisinha &amp; Andrews, 2004</td>
<td>1 male, and 1 female (ages 16 and 20) participants</td>
<td>Multiple baseline design across</td>
<td>Prompting, physical guidance, natural reinforcement</td>
<td>Expressive: VOCA + Gesture sessions, opportunity blocks</td>
<td>~ 30</td>
<td>- Participants learned to use VOCA to repair communication breakdown and to make spontaneous requests; - Increase in combined use of gestures and VOCA - Decrease in gestures alone - No social validation data provided - Generalization not provided (IV)</td>
</tr>
</tbody>
</table>

Note: CAI = computer assisted instruction; VOD = Voice Output Device; VOCA = Voice Output Communication Aid; PI: personal instruction; ~ = approximate value; CA: chronological age (years); Generalization/ Maintenance: I. Documented changes in at least one natural setting outside of treatment setting; II. Generalization to one other setting/skill/partner or maintenance beyond experimental intervention in natural setting in which intervention took place; III. Intervention occurred in natural setting or use of outcome measures with documented relationship to functional outcome; IV Not addressed or other (adapted from NRC, 2001)
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<th>Dependent Variables</th>
<th>Duration</th>
<th>General findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keen, Sigafoos,</td>
<td>3 males; 1</td>
<td>Multiple probe across behaviors</td>
<td>Manual signs, pictures, and verbalizations</td>
<td>Expressive: signs, pictures, verbalization</td>
<td>18 – 24 sessions</td>
<td>All participants showed increase in replacement behavior and decrease in prelinguistic behaviors; No social validation data; - Generalization not addressed (IV)</td>
</tr>
<tr>
<td>Woodyat, 2001</td>
<td>female CA: 3-7</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Kozleski, 1991</td>
<td>2 males; 2</td>
<td>Multiple baseline design</td>
<td>Discrete trial + Contingent reinforcement</td>
<td>Expressive use of symbols</td>
<td>~ 17 – 35 sessions</td>
<td>- Participants reached criterion with fewer trials in systems with higher degree of iconicity; - Rebus and photopictorial systems required fewest numbers of trials; - No social validation data provided; - Generalization not provided (IV)</td>
</tr>
</tbody>
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Table 1.4 Continued

<table>
<thead>
<tr>
<th>Author</th>
<th>Participants</th>
<th>Design</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Duration</th>
<th>General findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light, Roberts,</td>
<td>1 male</td>
<td>Case report</td>
<td>Computer with</td>
<td>Receptive and</td>
<td>~ 2 years</td>
<td>- Gains in receptive and expressive communication;</td>
</tr>
<tr>
<td>Dimarco, Greiner</td>
<td>CA: 6</td>
<td>Descriptive study</td>
<td>VOD + communication</td>
<td>expressive communicat</td>
<td></td>
<td>- Use of multiple aided and unaided systems; -</td>
</tr>
<tr>
<td>1998</td>
<td></td>
<td></td>
<td>book + gestures</td>
<td>on</td>
<td></td>
<td>Maintenance after 2 years (II); - Social validity</td>
</tr>
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<td>addressed</td>
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</table>

Note: VOD: voice output device; ; ~ = approximate value; CA: chronological age (years); Generalization/ Maintenance: I. Documented changes in at least one natural setting outside of treatment setting; II. Generalization to one other setting/skill/partner or maintenance beyond experimental intervention in natural setting in which intervention took place; III. Intervention occurred in natural setting or use of outcome measures with documented relationship to functional outcome; IV Not addressed or other (adapted from NRC, 2001)
Caregiver-Implemented Naturalistic Strategies with Children with ASD

Intervention strategies that aim at developing functional communication skills are critical for individuals that present socio-communicative deficits, such as those with ASD. The studies that have focused on this type of intervention have, in the last decades, moved from traditional behavioral frameworks (such as discrete trial-traditional behavior – DT-TB) to more contemporary behavioral and developmental social-pragmatic approaches (Prizant, Wetherby & Rydell, 2000; Prizant & Wetherby, 1998; Quill, 1995). Although these models share common principles regarding the nature of ASD, they diverge in their intervention procedures.

The behavioral model is rooted in the principles of operant conditioning. The interventionist arranges the learning environment, uses prompts and shaping techniques to help the child master a series of discrete subskills in order to develop a predetermined ability. It is an adult-directed intervention model that primarily places the child in a respondent role (Prizant et al., 2000; Quill, 1995). Generalizations of the learned skills are thoroughly programmed for after the child has mastered the desired response in the training settings.

Contemporary behavioral approaches, such as those that use naturalistic teaching procedures, were developed in response to the persistent concerns about the lack of generalization produced in traditional behavioral models (Prizant & Wetherby, 1998; Prizant et al, 2000). Specifically, the highly structured face-to-face settings characteristic of traditional behavioral frameworks did not seem to provide enough variability to promote generalization of learned skills to other, less structured environments (Lovaas, 1977). Additionally, discrete trial teaching seemed difficult and time-consuming to incorporate into a child’s daily routine since it required a one-to-one child-adult interaction (Charlop-Christy & Carpenter, 2000; Rogers-Warren & Warren, 1980).

Naturalistic procedures focus on teaching communication/language skills to a child in the natural environment during typical every-day interactions in order to foster generalization. These procedures refer to a group of intervention techniques based on principles originated from the developmental literature on child-caregiver interaction, developmental pragmatics and Applied Behavior Analysis (Prizant et al., 2000). This language intervention approach is also grounded on the assumption that intervention will occur in those settings where language is most functional for the child (Kaiser et al., 2000). Despite some theoretical and practical divergences,
the strategies included under the general rubric of naturalistic procedures share the following principles: (a) the teacher is encouraged to follow the child’s lead of attention; (b) child’s preferred activities provide the primary context of the interaction; (c) interactions are loosely structured, rather than following a predetermined protocol; and (d) the teacher is highly responsive to the child’s communicative attempts (Prizant et al., 2000). Among the most commonly cited naturalistic procedures are incidental teaching (Hart & Risley, 1975), natural language paradigm/pivotal response training (Koegel, Symon & Koegel, 2002), milieu teaching (Alpert & Kaiser, 1992; Warren, McQuarter & Rogers-Warren, 1984), and enhanced milieu teaching (Kaiser, Yoder & Keetz, 1992). Amidst the teaching techniques and conditions used in some of these procedures include mand-model (Warren et al., 1984); time-delay (Halle, Baer & Spradlin, 1981); waiting with “questioning look” (McGee et al., 1999); environmental arrangement (Kaiser, Ostrosky & Alpert, 1993); naturally occurring reinforcement (Koegel, 1999); and contingent imitation (Hwang & Hughes, 2000; Tiegerman & Primavera, 1984).

The developmental Social-Pragmatic Model (DSP) shares many of the instructional techniques derived from naturalistic teaching procedures adopted in the contemporary behavioral approaches. It, however, uses social pragmatics as a theoretical base and places less emphasis on eliciting and measuring discrete behavioral responses than traditional or contemporary ABA approaches (Prizant et al, 2000). It also focuses on the relationship between communication and socioemotional development and between language and play development in a greater extent than contemporary ABA models (Prizant et al, 2000).

Many of the teaching procedures used in the contemporary ABA approach and the DSP model have been successfully applied within a caregiver (parent or teacher) training format to enhance socio-communicative skills of children with ASD (Charlop-Christy & Carpenter, 2000; Dyer, Williams & Luce, 1991; Hancock & Kaiser, 2002; ; Kaiser et al., 1993; Kaiser et al., 2000; Koegel, Bimbela & Schreibman, 1996; Koegel et al., 2002; Laski, Charlop & Schriebman, 1988; Sigafoos & Littlewood, 1999; Smith & Camarata, 1999; Stiebel, 1999). The examination of the outcomes of these interventions is essential to determine the effectiveness of using such procedures with this population. In this section, a critical examination of the studies published on caregiver-implemented naturalistic interventions with individuals with ASD will be discussed. This analysis will be guided by the following topics: (a) the types of naturalistic strategies used;
(b) participant characteristics; (c) types of intervention methods; (d) settings, generalization and duration; (e) reliability measures and social validation; and the (f) effects of intervention.

Peer-reviewed investigations from the fields of special education, communication disorders and psychology published in the years 1980 through 2004 were consulted. The search method consisted of three strategies: computerized searches, hand searches and footnote inspection. Initially, a computerized database search using PsycINFO and Educational Resources Information Center (ERIC) was conducted. Then, the use of other authors’ references was utilized.

The articles found in these references were included in this review considering four selection criteria. First, the investigations had to involve participants with a diagnosis of autistic spectrum disorder (including autistic disorder, pervasive developmental disorder not otherwise specified [PDD-NOS], Asperger’s Disorder, and Childhood Disintegrative Disorder). Second, the study had to involve parents or other primary caregivers (e.g. grandparents, aunts) as interventionists or co-interventionists. Third, the investigation had to report measures of some aspect of language (form, content or use). Fourth, only studies that used teaching strategies derived from a naturalistic paradigm were included in this analysis. More precisely, these included approaches where: (a) teaching followed the child’s choice, lead or interest; (b) multiple, naturally occurring examples were provided to teach language; (c) the child’s production of language was explicitly prompted; (d) natural reinforcers were used to increase the child’s rate of response; (e) the teaching episodes were embedded in ongoing interactions (Koegel, 1999). A total of eight published studies met these criteria.

**Types of Naturalistic Strategies Used**

Three general teaching packages were identified in the eight studies analyzed. Five investigations used the Natural Language Paradigm/ Pivotal Response Training (Koegel et al., 2002; Koegel et al., 1996; Laski et al., 1988; Stiebel, 1999). Kaiser and colleagues (2000) applied Enhance Milieu Teaching (EMT); Yoder and Warren (2002) used Prelinguistic Milieu Teaching; Charlop-Christy and Carpenter (2000) applied Incidental Teaching and Modified Incidental Teaching; and Woods, Kashinath & Goldstein (2004) used a combination of naturalistic techniques. Despite differences in terminology, the techniques most commonly defined in these procedures were: (a) environmental arrangement (Charlop-Christy & Carpenter, 2000; Kaiser et al., 2000; 1991; Stiebel, 1999); (b) modeling (Laski et al., 1988; Woods et al.,
(c) Environmental arrangement (Kaiser et al., 1993) - the physical arrangement of the environment with the objective of inciting the child to communicate in order to access desired objects or activities. This procedure has been reported to enhance verbal and nonverbal initiations of children with language delays, including those with ASD (Hemmeter & Kaiser, 1990; Kaiser et al., 1993).

(b) Modeling (Alpert & Kaiser, 1992) – a procedure where the communication partner provides the appropriate language model related to an object/activity that is the focus of the child’s attention. For example, when the child looks at a preferred toy (e.g. teddy bear), the social partner provides its label using verbal language or nonverbal communication means (e.g. show picture of teddy bear on a communication board or provides the manual sign). If the child makes the correct verbal or nonverbal response, the social partner praises the child and gives her/him the desired toy. This procedure has been reported to increase verbal responsiveness and initiations in children with ASD (Laski et al., 1988).

(c) Mand-model (Warren et al., 1984) - the mand-model technique builds upon the modeling procedure previously described. In this approach, the communication partner observes the child’s focus of attention (e.g. teddy bear) and mands (requests) a response (e.g., “tell me what you want”). If the child responds correctly (e.g. “teddy bear”), the social partner praises the child and gives her/him the desired toy. If the child provides an incorrect response (e.g. “ball”), the social partner models the appropriate answer (e.g. “say teddy bear”). This procedure may be useful for children with very low rates of initiation (Rogers-Warren & Warren, 1980).

(d) Natural reinforcers/ contingent praise - the provision of natural occurring consequences for the child’s response (Koegel, 1999). If the child requests a “toy” by using gestures, vocalizations or verbal language, the requested toy is given to her.
(e) **Prompting** – the child is incited to communicate by using diverse cues. This may be done by providing a delay to provide opportunities for the child to use language or verbally asking the child what he/she wants (Koegel, 1999).

(f) **Time-delay/ Waiting/ Delayed prompt procedure** (Halle et al., 1981) – it is a language intervention strategy which focuses on teaching children to initiate verbal interactions. In this procedure, the social partner identifies an object/activity that is of the child’s interest and waits for a response. If the child fails to respond correctly, the social partner waits again for another response. If the child does not respond appropriately, the social partner applies the mand-model procedure previously described. This technique has been reported to enhance the frequency of eye-contact, joint attention and motor imitation of young children with ASD (Hwang & Hughes, 2000).

(g) **Contingent imitation** – it is a language intervention strategy where the partner imitates the child’s actions using toys, body movements, and vocalizations simultaneously or as soon as possible after the child initiates the action (Hwang & Hughes, 2000). The research literature has suggested that the use of this procedure may enhance eye-contact, joint-attention and motor imitation of children with ASD (Hwang & Hughes, 2000; Tiegerman & Primavera, 1981, 1984).

**Participant Characteristics**

In total, thirty-eight children with a diagnosis of autism, PDD-NOS or Aspergers were involved in these 8 investigations. The majority of them were between three and five years of age. Two studies (Kaiser et al., 2000; Woods et al., 2004) involved children that were below three years of age; three had participants between 4 and 8 (Charlop-Christy & Carpenter, 2000; Koegel et al., 1996; Stiebel, 1999); two studies (Charlop-Christy & Carpenter, 2000; Laski et al., 1988) included children who were 9 years old and the other investigation did not specify the chronological age of the participants with ASD (Yoder & Warren, 2002). The authors specified the child’s race and ethnicity in only three investigations (Charlop-Christy & Carpenter, 2000; Woods et al., 2004; Yoder & Warren, 2002).

Delays in the development of 10 individuals were measured using the Vineland Behavior Scales (Sparrow, Balla & Cicchetti, 1984). The Standford Binet intelligence test, the Merril Palmer tests or general descriptive data were used to report the mental abilities of 17 individuals. Fourteen children were regarded as mildly/severely mentally retarded and three functioned within the normal range. Data on the mental or adaptive skills of 11 children were not specified.
In terms of communication/language development, one study (Kaiser et al., 2000) used the Sequenced Inventory of Communication Development (Hedrick, Prather, & Tobin, 1984); one (Charlop-Christy & Carpenter, 2000) used the Minnesota Child Development (Ireton & Thwing, 1974); one used the Communication and Symbolic Behavior Scale-Diagnostic Profile (Wetherby & Prizant, 2002); and other 2 investigations (Koegel et al., 1996; Stiebel, 1999) provided standard scores from the Vineland Behavior Scale (Sparrow et al, 1984). Eighteen children were described either as nonverbal, presenting moderate or significant expressive delays or having a limited expressive vocabulary (3-5 words). Six were defined either as echolalic, capable of producing more than ten words spontaneously or constructing 3-word utterances. Three studies (Koegel et al., 2002; Laski et al., 1988; Stiebel, 1999) failed to provide data on the receptive skills of the participants involved. The studies that used standardized measures failed to furnish a clear description of the children’s expressive or receptive repertoire. In sum, most participants of the studies analyzed presented language/communication delays, were between ages 3-5 and had some degree of mental retardation.

Two intervention studies were conducted solely with the child and the mother (Kaiser et al., 2000; Woods et al., 2004). Two investigations (Laski et al., 1988; Yoder & Warren, 2002) did not specify who the child’s caregiver was, only stating that it was a primary caretaker. Three (Charlop-Christy & Carpenter, 2000; Koegel et al., 1996; Stiebel, 1999) involved both parents; and one intervention additionally included the child’s grandmother and aunt (Koegel et al., 2002). Only two of the studies provided information regarding caregivers’ age, which ranged from 28-37 years (Kaiser et al., 2000; Woods et al., 2004). Two investigations included their socio-economic status (SES) (Koegel et al., 1996; Koegel et al., 2002) and three indicated their educational levels (Kaiser et al., 2000; Koegel et al., 2002; Woods et al., 2004). In these studies caretakers were mostly from middle-class families and had at least a high-school degree. Only Woods and colleagues (2004) specified the participants’ ethnicity/race. The scarce data on these issues represent a serious problem on the generalization of the results obtained in these studies. In other words, it is questionable if this type of intervention could be successfully applied to the full spectrum of socioeconomic status, ethnicities or race.

Types of Intervention Methods

Most researchers opted for using some type of single subject design methodology to demonstrate the effects of the interventions (Charlop-Christy & Carpenter, 2000; Kaiser et al.,
2000; Koegel et al., 2002; Laski et al., 1988; Stiebel, 1999; Woods et al., 2004). Considering the small number of participants and the types of questions being addressed in these studies, this type of research methodology seemed adequate. Precisely, the use of single-subject designs are advisable when a limited number of participants are involved (Barlow & Hersen, 1984) and when researchers want to individualize intervention procedures without affecting experimental control (Barlow & Hersen, 1984). In the studies in question, researchers worked with a small number of families and particularized some aspects of treatment. In this sense, the context of the interactions and the length of treatment exposure within the same study varied considerably.

Despite the appropriateness of the designs, most studies (Charlop-Christy & Carpenter, 2000; Kaiser et al., 2000; Koegel et al., 2002; Stiebel, 1999) failed to specify which components of the intervention were responsible for the changes in the child variables. In other words, these investigations used “treatment packages” and did not conduct a component analysis to measure the specific effects of each strategy applied. This produces a confounding effect (Barlow & Hersen, 1984) and precludes the investigator from determining which independent variables from the package were actually responsible for the outcomes. Additionally, in this type of research design, it is crucial for the participants’ characteristics to be explicitly described in order for replications to occur (Barlow & Hersen, 1984). Many studies, however, provided poor descriptions of the children and caretakers involved.

Koegel and colleagues (1996) and Yoder & Warren (2002), on the other hand, compared the effects of treatment packages using randomly assigned groups. This methodology is regarded as one of the most powerful in detecting the effectiveness of an intervention (Wiersma, 2000). It requires, nonetheless, that the groups be homogeneous – which is sometimes a critical issue when considering the heterogeneous features of individuals with ASD. Koegel et al. (1996), however, was able to match the groups considering the children’s social maturity scores, age and demographic characteristics. Yoder & Warren (2000) additionally considered their mental ages, number of words understood and produced, as well as the number of symbols used. Caregiver variables were not addressed.

When working with small groups it is also essential to determine the magnitude of change that would be considered significant (Siegel & Castellan, 1988). Koegel and colleagues (1996) worked with a total of 17 children and Yoder and Warren (2002) involved 39 participants. The smaller the size of the group, the larger the difference in treatment outcomes has to be in
order to show a statistically different effect (NRC, 2001). A way of demonstrating that the differences in two procedures were, in fact, significant is to provide the magnitude of the difference in terms of effect size (Siegel & Castellan, 1988). Neither of these studies provided these or equivalent measures.

**General Procedures, Reliability and Social Validation Measures**

Caregivers were taught to use the intervention procedures through diverse modes, such as videotapes, modeling, written documents, and verbal feedback. Instructions were either provided to small groups of caregivers or one-to-one formats involving the caretaker, the child and a clinician. Clinic settings and/or the children’s homes were used in all of the studies involving parents. The classroom environment was used in all of the investigations involving teachers. One study (Koegel et al., 2002) additionally included community settings, such as restaurants, parks and hotels. It is pertinent to highlight that, despite the artificial nature of some settings (e.g. clinic), most of the interventions seemed loosely structured, with the caregiver following the child's lead of attention during child preferred activities.

The majority of the studies provided generalization or maintenance measures (Charlop-Christy & Carpenter, 2000; Kaiser et al., 2000; Koegel et al., 2002; Laski et al., 1988; Stiebel et al., 1999; Woods et al., 2004). The skills learned during the treatment conditions were, however, mostly assessed in generalization probes in similar routines or using identical objects/activities. The literature has shown that generalization and maintenance of treatment effects do not automatically occur as a result of an intervention (Schreibman, 2000). Therefore, it is pertinent to develop strategies to sustain learned behaviors across contexts and time. Only two investigations (Stiebel, 1999; Woods et al., 2004) explicitly focused on developing such strategies. In the first study, Stiebel (1999) developed a self-management training procedure where the parents learned *problem-solving* strategies to apply during troublesome routines. In the second intervention, Woods et al. (2004) focused on selecting strategies that were already in the caregivers’ repertoire and that could be implemented in multiple routines.

The duration and intensity of caregiver training prior to the intervention varied considerably. Careproviders were involved in intensive 25-hour intervention programs that lasted one week (Koegel et al., 2002); or were offered from 1 to 27 training sessions lasting from 15 to 90 minutes (Kaiser et al., 2000; Laski et al., 1988; Stiebel, 1999; Woods et al., 2004; Yoder & Warren, 2002). Four studies (Charlop-Christy & Carpenter, 2000; Kaiser et al., 2000; Koegel et
(al., 1996; Woods et al., 2004) stated that intervention with the careproviders continued until they demonstrated criterion use of the targeted strategies. The total length of time of the studies analyzed (including caregiver training, assessment of caregiver implementation of the strategies and follow-up sessions) ranged from 3 to 44 months.

Four studies reported measures of social validity (Charlop-Christy & Carpenter, 2000; Kaiser et al., 2000; Stiebel, 1999; Woods et al., 2004), stating that the caregivers were mostly satisfied with the effects of the intervention. All investigations provided adequate measures of reliability of the dependent variables. These studies used multiple independent observers that generally reached reliability rates not inferior to 80%.

Effects of Intervention

Frequency measures of caregiver use of the naturalistic teaching package were the dependent variables most commonly assessed in the studies analyzed. In general, all caregivers successfully learned to apply the intervention procedures with their children in natural language-learning settings. Only one study (Woods et al., 2004) provided detailed information concerning what types of strategies within the treatment packages were more effectively applied by each caregiver before, during or after the interventions. As discussed by Kashinath (2002), the appropriate assessment of the strategies applied by each individual caregiver provides valuable information regarding the interaction patterns of the child-caretaker dyads. These data assist in the individualization of treatment and consequently facilitate planning for generalization across environments.

The studies that compared levels of parental satisfaction in applying discrete trial and naturalistic procedures had varying results. Specifically, caregivers were scored as presenting more positive affect when using a naturalistic paradigm (Pivotal Response Training) than a traditional behavioral approach in the study conducted by Koegel et al. (1996). On the other hand, in the investigation held by Charlop-Christy & Carpenter (2000) parental satisfaction with the implementation of 2 naturalistic procedures (incidental teaching and modified incidental teaching) and a discrete-trial model did not vary significantly. The discrepancy of these results may be discussed using two arguments. First, the parental satisfaction was measured using different constructs. In one study (Charlop-Christy & Carpenter, 2000), satisfaction was assessed by parental perception regarding the ease of implementing the proposed strategies and the child’s learning speed. In the other investigation (Koegel et al., 1996) independent observers watched
the parents implementing the strategies and evaluated their levels of happiness, interest and stress using a 6-point Likert scale. Major differences in the types of strategies applied within each study may also be responsible for the discrepant results. Charlop-Christy & Carpenter (2000) for example used only time-delay and positive reinforcement in their investigation. Koegel et al. (1996) on the other hand, applied a full range of techniques derived from both paradigms in more elaborated scenarios. This bolsters the need for identifying specific strategies that are more positively perceived by the caregivers and more effective at promoting language development in studies that use treatment packages.

The majority of the investigations also measured the effects of the intervention on the child’s communication/language performance (Charlop-Christy & Carpenter, 2000; Kaiser et al., 2000; Koegel et al., 2002; Laski et al., 1988; Stiebel, 1999; Woods et al., 2004; Yoder & Warren, 2002;). Some studies (Kaiser et al., 2000; Woods et al., 2004; Yoder & Warren, 2002) used structured tools such as the Peabody Picture Vocabulary Test-Revised (Dunn & Dunn, 1981), the Expressive One-Word Picture Vocabulary Test (Gardner, 1990) (Kaiser et al., 2000); and the Communication and Symbolic Behavior Scales (Wetherby & Prizant, 2002). Other investigations measured the frequency of child verbalizations/vocalizations (Charlop-Christy & Carpenter; 2000; Kaiser et al., 2000; Koegel et al., 2002; Laski et al., 1988; Woods et al., 2004;) changes in the children’s Mean Length of Utterances (MLU) (Kaiser et al., 2000); nonverbal communicative behaviors (Woods et al., 2004; Yoder & Warren, 2002); and the use of a picture communication system (Stiebel, 1999). In general, these studies showed that the use of naturalistic teaching procedures applied within a parent-implemented format were effective at promoting language/communication in young children with ASD.
<table>
<thead>
<tr>
<th>Author</th>
<th>Participants</th>
<th>Design</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Duration</th>
<th>General findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charlop-Christy &amp; Carpenter, 2000</td>
<td>3 children</td>
<td>Alternating treatment design to compare 3 conditions</td>
<td>Modified incidental teaching</td>
<td>Child’s communication (verbalization) and parent’s use of the strategies</td>
<td>Baseline: 7-37 days Total: 111 sessions</td>
<td>- MITS - better acquisition and generalization of behavior than IC and DT; Children: increase in imitations + spontaneous speech and decrease in incorrect responses and imitative behaviors; Social validity: parents satisfaction with the 3 procedures; Generalization assessed</td>
</tr>
<tr>
<td>Kaiser, Hancock &amp; Nietfeld, 2000</td>
<td>6 children</td>
<td>Multiple baseline delay</td>
<td>Enhanced milieu Teaching (EMT): model, mand time delay</td>
<td>Child’s communication and parent’s use of the strategies</td>
<td>5-7 baseline; 45-minute sessions – 2x week; until reached criteria or completed 24 sessions</td>
<td>- All parents learned to expand their child’s utterances using EMT; 5 of the six parents used the milieu teaching procedures more correctly during follow up; All children showed increases in total use of targets; Changes in MLU with 3 children: - Parents generalized in some degree EMT to the home; Parent satisfaction survey: positive</td>
</tr>
<tr>
<td>Author</td>
<td>Participants</td>
<td>Design</td>
<td>Independent Variables</td>
<td>Dependent Variables</td>
<td>Duration</td>
<td>General findings</td>
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<tr>
<td>Koegel &amp; Koegel, 2002</td>
<td>5 children</td>
<td>Nonconcurrent multiple-baseline across participants</td>
<td>Pivotal Response Training (PRT)</td>
<td>Child’s communication and parent’s use of the strategies</td>
<td>25 hour intensive program – 5 days – 1 week: 5 hours follow-up: up to 3 months to 1 year later; Up to 13 probe sessions;</td>
<td>Parents effectively increased the use of PRT following intervention; Parent use of PRT maintained over time; S1 – from 20 to 71 words; S2 – 25 to 68 (after 4 months) S3 – 19 to 61; S4 – increase in expressive language 54-75; Social validity: Increase in affect of parental response</td>
</tr>
<tr>
<td>Koegel, Bimbela &amp; Schreibman, 1996</td>
<td>17 children</td>
<td>Comparison of 2 conditions</td>
<td>Pivot Response Training (PRT) and Individual Target Behavior (ITB)</td>
<td>Parent’s rate of satisfaction in using the PRT and ITB</td>
<td>34 videotape assessment; pre-specified criterion levels</td>
<td>- Parents were happier, more interested; less stressed; and expressed having more positive interactions when using PRT - Generalization not assessed - Social validity assessed</td>
</tr>
<tr>
<td>Author</td>
<td>Participants</td>
<td>Design</td>
<td>Independent Variables</td>
<td>Dependent Variables</td>
<td>Duration</td>
<td>General findings</td>
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<tr>
<td>Laski, Charlop &amp; Schreibman, 1988</td>
<td>8 children (age 5-9)</td>
<td>Multiple baseline</td>
<td>Natural Language Paradigm (NLP): mand-model and prompt</td>
<td>Child’s verbalizations and parent’s use of the strategies</td>
<td>~ 20 sessions; 5-9 sessions (to meet criterion level) of 15 minutes duration</td>
<td>- Following training, parents increased NLP use; Parent generalized strategy use to siblings of their children with autism; Inconsistent use of parent implemented procedures during follow-up; Children maintained high verbalizations at follow-up No social validity measures Generalization: taken in clinic and home</td>
</tr>
<tr>
<td>Stiebel, 1999</td>
<td>3 children CA: 4-6</td>
<td>Multiple baseline across child and parent behavior</td>
<td>Natural Language Paradigm</td>
<td>Child’s card use and parents use of strategies</td>
<td>~ 21-26 sessions (6 months)</td>
<td>- Parents learned to apply the teaching strategies; Children increased card use - Social validity assessed - Generalization in nontrained routines</td>
</tr>
<tr>
<td>Author</td>
<td>Participants</td>
<td>Design</td>
<td>Independent Variables</td>
<td>Dependent Variables</td>
<td>Duration</td>
<td>General findings</td>
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</tr>
<tr>
<td>Woods, Kashinath &amp; Goldstein, 2004</td>
<td>5 children CA: 1-2</td>
<td>Multiple baseline design</td>
<td>Imitation, waiting, modeling, expanding</td>
<td>Child’s communication and parent’s use of the strategies</td>
<td>~ 25 sessions</td>
<td>Parents learned to apply the strategies in trained and untrained routines. Children improved communication outcomes. Generalization assessed across routines</td>
</tr>
<tr>
<td>Yoder &amp; Warren, 2002</td>
<td>39 children (1 with autism)</td>
<td>Comparison: control group and PMT</td>
<td>Prelinguistic Milieu Teaching (PMT)</td>
<td>Child’s communication and parent’s use of the strategies</td>
<td>6 months (3-4 times per week) or - 20 minute sessions</td>
<td>- RMT – facilitated more frequent and more optimal parental response to child communication; Increase in child initiated comments; Generalization not assessed</td>
</tr>
</tbody>
</table>

Note: ~ = approximate value; CA: chronological age (years).
Routine-Based Interventions for Children with ASD

The growing research literature on child development has, in the last decades, shown that interactive routines between the social partner and the child facilitate communication and language development (Bruner, 1983; Quill, 1995; Tomasello, 1988). A routine is defined “a functional event of daily living that offers opportunities to teach and practice meaningful skills in settings and situations as they are needed” (Cripe & Venn, 1997). Interactive routines take place when 2 or more participants engage in social interactions cooperatively to accomplish a particular goal (Prizant et al, 2000; Snyder-Mc Lean, Solomonson, McLean and Sack, 1984). These events are characterized by limited, sequential and predictable sets of contextually meaningful utterances that allow a child to anticipate and insert appropriate responses (Quill, 1995). An interactive routine can occur during every day habitual actions like setting the table or getting dressed. They can happen during predictable play activities like building a railroad for a toy train or playing peek-a-boo with the caregiver. In any of these activities it is important to provide roles that are clear, reversible, meaningful and consistent.

Routines can be related to the fabrication or preparation of a specific product (e.g. food preparation; setting a table); they may involve an action organized around a plot or theme (e.g. dressing); or include cooperative turn-taking games (e.g. peek-a-boo) (Snyder-McLean, et al., 1984). Regardless of the type of routine, it is crucial that the interaction include: (1) a unifying theme or purpose; (2) a clear beginning and ending point; (3) require joint focus and interaction; (4) limited number of clearly delineated roles (e.g. speaker/ listener); (5) have a sequence of steps or logical order; (6) have interesting elements for the child’s engagement; (7) have opportunities for repetition; (8) have a motivating or reinforcing outcome (Cripe & Venn, 1997; Snyder-McLean et al., 1984).

As identified in the research literature (Dunst, Hamby, Trivette, Raab & Bruder, 2000; Dunst & Bruder, 1999; Kashinath, 2002) routines can be grouped in diverse categories, considering their social context or the physical environments where they take place. Dunst and colleagues (2000) in a national survey applied with families in the United States identified 22 different categories of routines where learning opportunities were enhanced. These included from simple child routines, such as brushing teeth and cleaning up the room, to more socially complex
activities, such as *family celebrations*, which included holiday dinners and family members’ birthdays.

The idea of implementing intervention within the child’s daily routines derives from an ecological system approach, where quotidian experiences are viewed as fundamental sources that provide essential learning opportunities for the child (Bronfenbrenner, 1992). Embedding treatment within these routines is a form of maximizing learning opportunities for the child. Although caregivers may function as the primary – and perhaps the most effective – teachers for small children, they may inadvertently preempt important learning opportunities for them (Halle, 1984). This is specially the case of careproviders of children with severe language deficits, such as those with ASD. Considering that language is an interactive process and that children with ASD may not consistently respond to the caregivers’ language requests, it is plausible to think that the careprovider will minimize her “teaching efforts” due to the lack of child response (Rogers-Warren & Warren, 1983). In this case it is important to identify relevant language-learning opportunities that may be unwittingly ignored by family members. From this point it becomes critical not only to teach effective strategies to meet the family’s needs, but also build upon their strengths. This initially requires understanding the family’s dynamic, respecting their culture, beliefs, perceptions and priorities. Then, it is fundamental to plan for their active participation, sharing in decision-making and building unity (Woods & Wetherby, 2003). Effectively partnering with careproviders enhances the likelihood that the family will repeat the therapeutic activity independently (Hanft & Pildkington, 2000), favoring the generalization of the skills learned by the child.

Active caregiver involvement in routine-based interventions has been reported to create effective language learning opportunities for children with ASD (Kashinath, 2002; Stiebel, 1999). The use of routines as the context for intervention seems especially relevant for this population when considering their motivation in performing predictable and repetitive actions (Janzen, 1996). As discussed in the literature, children with autism frequently learn tasks presented in a structures concrete format more easily than tasks presented in a more abstract format (Schopler, Mesibov & Hearsey, 1995). When these interactions are held in natural environments with significant social partners, skills are learned under the condition of ordinary everyday settings, facilitating the generalization of targeted behaviors (Halle, 1984).
Purpose of the Study

Despite the encouraging outcomes of using AAC systems with individuals with ASD and the effectiveness of training parents to use naturalistic teaching procedures to enhance communication in this population, a limited number of investigations combining these topics have been conducted in the last 25 years. Many of the AAC studies involving participants with ASD have focused on enhancing language production skills, conducted interventions in artificial language-learning settings, and typically failed to include caregivers as primary intervention agents. The studies that have focused on the use of caregiver-implemented naturalistic teaching to enhance the communication/language skills of individuals with ASD have mostly focused on the development of verbal language, neglecting the effects of these procedures in the language/communication skills of AAC users.

This study aimed at extending the current lines of research in the field of AAC and caregiver-implemented naturalistic teaching in the communication development of individuals with ASD using AAC systems. The purpose of this investigation was to: (1) determine if caregivers can learn to implement naturalistic teaching strategies using visual-graphic systems of communication during home routines; (2) identify changes in the child’s communication mode (vocalization/verbalization; gestures/signs; and aided systems), communication turn (initiation and response), and imitative responses with the implementation of the treatment; (3) evaluate the caregivers’ perception of the teaching program; (4) evaluate the caregivers’ perception of the children’s communication gains using the AAC system; (5) evaluate the opportunities provided by the caregivers for the children to use the system in nonintervention contexts.
CHAPETER 2
METHOD

The purpose of this study was to examine the use and effects of caregiver-implemented naturalistic teaching on the communication outcomes of young children with autism using aided systems of communication. This study extended prior research by Stiebel (1999). In that study, the researcher taught parents of children with ASD to use a series of naturalistic techniques to promote AAC use during daily routines. The investigation reported positive outcomes but failed to specify the frequency of use of each intervention strategy utilized by the parent. Additionally, the researcher evaluated the percentage of child spontaneous AAC use and did not address child-prompted responses or the use of other modes of communication, such as gestures, signs or speech.

The current study extended the research literature by specifying the frequency of use of each naturalistic strategy utilized by the caregivers and its impact on the child’s responses. It also addressed the effects of the intervention on the child’s spontaneous and prompted responses using verbalizations/vocalizations and gestures/manual signs, other than the augmentative device. The researcher anticipated that, following the parent-training intervention, caregivers would apply the naturalistic teaching strategies with greater frequency. Parents would also promote additional opportunities for child use of the AAC system in alternative settings, other than the experimental sessions. As a result of this intervention, the children would increase the number of spontaneous, prompted, and imitative responses using the AAC device, manual signs/gestures and vocalizations/verbalizations. Specifically, five primary questions were examined:

(1) Can caregivers learn to implement naturalistic teaching strategies using visual-graphic systems of communication during home routines?
(2) What changes in the children’s communication modes (vocalization/ verbalization; gestures/signs; and aided systems) frequency of communication turns (initiations and responses), and imitative responses are observed with the implementation of this intervention?

(3) How does the caregiver evaluate this intervention program?

(4) Does the caregiver perceive any changes in the child’s communication abilities following the intervention?

Participants

A total of four children with ASD and their caregivers were recruited from the Florida State University Center for Autism and Related Disabilities (CARD) and the Florida State University Autism Spectrum Specialized Education and Training Project (ASSET). A CARD coordinator or the ASSET project co-director contacted families of children with ASD between 3 and 8 years of age that were currently on the CARD registry. Interested families were sent a letter explaining the purpose and the requirements of the study. This letter, approved by the IRB/Human Subjects University Committee, instructed caregivers to contact the researcher for further information (See Appendix A). Once the families contacted the researcher, a home visit was scheduled to discuss the study’s objectives and to obtain the caregiver’s informed consent. Three of the four families contacted completed all phases of the study, whereas one family dropped out during the caregiver intervention phase because family responsibilities did not allow adequate time to participate. The inclusion of children and caregivers in this study was based on the following criteria:

- A primary diagnosis of ASD, as determined by the Childhood Autism Rating Scale (CARS; Schopler, Reichler & Renner, 1988);
- A score between 3 (moderately abnormal) and 4 (severely abnormal) in verbal communication skills as measured by CARS (Schopler et al., 1988);
- Age between 3 and 8 years; and
- Caregivers agreed to be videotaped with their child in the home setting;

Child Participants

Four children between 4 years and 6 months and 8 years and 11 months of age participated in this study. Information about the children was obtained from the child's files from
the Florida State University Center for Autism and Related Disabilities (CARD), interviews with
the caregivers, and from individual child evaluations conducted by the researcher. The children’s
level of autism was rated based on the Childhood Autism Rating Scale (CARS; Schopler et al.,
1988). Expressive and receptive language measures were obtained by the Peabody Picture
Vocabulary Test (PPVT-III; Dunn & Dunn, 1997), the Expressive One Word Picture Vocabulary
Test (EOWPVT; Gardner, 2000), the Preschool Language Scale (PLS-IV; Zimmerman, Violette,
Steiner, & Pond, 2002) and the Learning Assessment Profile (LAP; Glover, Preminger, Sanford,
Zelman, 1995). The children’s speech, hearing, visual, motor and cognitive abilities were
assessed through caregiver interview and school/medical reports.

Table 2.1
Child Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Barney</th>
<th>Charlie</th>
<th>Jason</th>
<th>Kevin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age years/months</td>
<td>8.11</td>
<td>5.8</td>
<td>4.6</td>
<td>6.4</td>
</tr>
<tr>
<td>Race</td>
<td>Caucasian</td>
<td>Caucasian</td>
<td>African-American</td>
<td>Caucasian</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Autism, Seizure Disorder, Attention Deficit Disorder</td>
<td>Autism</td>
<td>Autism</td>
<td>Autism and Seizure Disorder</td>
</tr>
<tr>
<td>CARS</td>
<td>36 (mildly-moderately autistic)</td>
<td>41.5 (severely autistic)</td>
<td>36 (mildly-moderately autistic)</td>
<td>31 (mildly-moderately autistic)</td>
</tr>
<tr>
<td>Expressive Language</td>
<td>SS = 50; PR = 1; AE = 22 months (PLS-IV)</td>
<td>SS = 57; PR = 1; AE = 22 months (PLS-IV)</td>
<td>AE = 21 months (LAP); EOWPVT untestable</td>
<td>SS = 55; PR=&lt;1 AE = 24 months (EOWPVT)</td>
</tr>
</tbody>
</table>
Table 2.1 Continued

<table>
<thead>
<tr>
<th></th>
<th>Barney</th>
<th>Charlie</th>
<th>Jason</th>
<th>Kevin</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Receptive Language</strong></td>
<td>SS = 40; PR=&lt;1</td>
<td>SS = 50; PR = 1;</td>
<td>AE = 21 months (LAP); PPVT-III – untestable</td>
<td>SS = 46; PR=&lt;1</td>
</tr>
<tr>
<td></td>
<td>AE = 21 months (PPVT-III)</td>
<td>AE = 22 months (PLS-IV)</td>
<td>AE = 21 months (PPVT-III)</td>
<td>AE = 21 months (PPVT-III)</td>
</tr>
<tr>
<td><strong>Speech</strong></td>
<td>Immediate echolalia;</td>
<td>Nonverbal</td>
<td>Nonverbal</td>
<td>Some functional speech; mostly unintelligible; echolalia</td>
</tr>
<tr>
<td></td>
<td>No functional spontaneous speech</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hearing</strong></td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td><strong>Vision</strong></td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td><strong>Motor</strong></td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Gross and fine motor impairments</td>
</tr>
<tr>
<td><strong>Cognition</strong></td>
<td>Moderate-severe mental retardation: IQ=34 (SB-IV)</td>
<td>Not assessed</td>
<td>AE = 24 months (LAP)</td>
<td>Mental retardation</td>
</tr>
</tbody>
</table>

Note: SS = Standard Score; PR = Percentile Rank; AE = age equivalent; PLS-IV = Preschool Language Scale; PPVT = Peabody Picture Vocabulary Test; LAP = Learning Assessment Profile; EOWPVT = Expressive One Word Picture Vocabulary Test; Untestable – More than 8 errors happened in the first test set, characterizing the child as “untestable”. SB = Stanford-Binet Intelligence Scale; 1. Data obtained through caregiver interview, school, and medical reports.

**Barney.** Barney was an 8-year 11 month-old boy who lived in a middle-class home with his mother, father, 2-year-old sister and 7-year-old brother. Barney attended a special education
classroom for children with disabilities at a public school. He received speech and occupational therapy once a week at a private clinic.

Barney had a diagnosis of intractable epilepsy, autism and attention deficit disorder. Because of his severe seizure disorder, he had an implantation of a vagal nerve stimulator. He constantly had minor seizure episodes and rarely displayed any severe seizure attacks. Barney had normal hearing, visual, and motor abilities. Medical records indicated that he had moderate-severe mental retardation, as measured by the Stanford-Binet Intelligence Scale.

He had no previous exposure to expressive alternative communication systems prior to this investigation and exhibited expressive language skills equivalent to a 23-month-old child, as measured by the PLS-IV. Barney would occasionally say “no” to indicate he did not want to engage in an activity, but overall failed to use speech functionally. He displayed immediate echolalia and would sporadically say from 5 to 6 words or simple sentences, which appeared to be delayed echolalia with no apparent communicative function. Barney rarely initiated social interactions and, at times, displayed aversion to social touch or proximity. He relied primarily on nonverbal communication repertoire, such as pulling, reaching, grabbing, and gazing to request assistance or desired objects. In general, he would make eye contact with the social partner and stare at an item he wanted. He would typically protest by crying, screaming, or vocalizing. Barney failed to use any distal gestures, such as pointing to objects that were out of reach or showing objects to social partners.

Barney had an auditory comprehension equivalent to a 23 month-old child, as measured by the PLS-IV. His vocabulary comprehension was equivalent to a 21-month old child, as measured by the PPVT. He was able to comprehend simple one-step verbal instructions, mainly when accompanied by contextual cues. His parents had recently started using picture communication cards to enhance Barney’s speech comprehension during mealtime. These were photographs and PCS symbols of food items that were presented to Barney as choices. The caregivers would show Barney two food cards, for instance, and ask him to make a choice. Direct observation and caregiver interview revealed that Barney was able to comprehend the symbols on the communication cards and make appropriate choices.

Barney had difficulty transitioning from one activity to another and demonstrated repetitive repertoires of behaviors. He enjoyed playing with Legos, coloring and manipulating sand. His play skills, however, were essentially constructive and he was never observed engaging
in more symbolic interactions. The objects he manipulated during play seemed to be essentially for self-stimulation.

**Charlie.** Charlie was a 5-year 6-month old boy who lived with his mother, father, 6-year-old sister and 10-year-old brother. He was enrolled in a special education classroom at a public school, where he additionally received services from a speech pathologist and an occupational therapist. Parent interview indicated that Charlie’s hearing, vision, and motor abilities were within normal limits. His cognitive skills had never been assessed.

He had a one-month exposure to the PECS system (Bondy & Frost, 1994) at school one year prior to this study. Since the family moved to another state, he did not complete the program or learn to use the communication system in other settings. Charlie had expressive language skills equivalent to a 22-month old, as measured by the PLS-IV. He was nonverbal and essentially used unconventional gestures to communicate. In general, he would use a person’s hand as a tool without direct eye gaze. He did not point or show objects to others. He presented abnormal gaze, infrequently initiated social interactions, and did not share affective states. He was reported to consistently engage in self-injurious behaviors, such as biting his hand or banging his head on a hard surface when communication breakdowns occurred.

Charlie did not achieve a basal score on the PPVT, as he did not seem to understand the task demands. He had an auditory comprehension equivalent to a 21-month-old child, as measured by the PLS-IV. In terms of receptive language, he was able to comprehend simple verbal instructions when accompanied by contextual cues.

Charlie exhibited a range of repetitive behaviors, such as hand flapping and finger flickering. He had unusual sensory interests and often displayed distress when objects or routines were unexpectedly modified. He enjoyed watching TV, playing with stuffed animals, putting puzzles together, and rough playing with his older brother. He exhibited some symbolic play skills, such as pretending that a piece of play dough was an animal.

**Jason.** When the study began, Jason was 4 years and 6 months old. He lived with his mother, a 7-year-old sister, his grandmother and grandfather. His mother returned to the home after a 2 year absence and was re-establishing her role as primary caregiver for Jason. He was enrolled in a private full-inclusive preschool program. Parent interview and school records indicated that Jason had no hearing or visual impairments. He had gross and fine motor abilities
equivalent to a 36-moth-old child, as measured by the LAP. His cognitive abilities were significantly delayed, as he functioned at a 24-month-old level.

Two years prior to this study, Jason had been involved in an AAC intervention program for 7-months. In this program, his grandmother learned to use a number of naturalistic communication strategies to teach him to use picture cards to make requests. Some of the cards used during that period were still attached to the family’s refrigerator door. According to parent interview, however, the grandmother was not reported to use the symbols with the child following the termination of the program. Caregiver interview and direct home observations indicated that Jason did not spontaneously use any aided or unaided system of communication at the onset of the current investigation.

Jason’s responses were not able to be scored according to the standardized procedures of the EOWPVT. Recent school records, however, indicated expressive language skills equivalent to a 21-month-old child, as measured by the LAP. He did not use any verbal language to communicate, but relied primarily on contact gestures. In general, he would make eye contact with a social partner and direct his/her hand towards desired objects/actions. He failed to use distal gestures, such as pointing to objects out of reach or showing objects to others. He presented abnormal gaze, but was reported to appropriately initiate social interactions and share affective states with others.

Jason could not be tested on the PPVT-IV. As indicated by school records, however, he had receptive language skills equivalent to a 21-month-old child, as measured by the LAP. He exhibited limited verbal comprehension and followed simple instructions when they were accompanied by contextual cues. Jason displayed consistent repetitive behaviors and unusual sensory interests. He enjoyed watching TV, playing with other children, putting puzzles together, and coloring. He did not exhibit any symbolic play skills.

Kevin. Kevin was a six-year and four-month-old boy who lived with his biological mother in a middle-class neighborhood. He received his education in a special education classroom for children with disabilities at a public school. Additionally, Kevin daily attended an after-school program directed for children with special needs.

Kevin had a diagnosis of seizure disorder and was often hospitalized in severe crisis. Medical records revealed that he had normal hearing and visual abilities, but displayed significant motor and cognitive delays. Kevin had an expressive vocabulary equivalent to a 27-
month-old child, as measured by the EOWPVT. He used verbal language as his primary mode of communication. His speech, however, was dysarthric and mostly unintelligible. He displayed immediate echolalia and occasionally used from 3 to 4 basic manual signs (e.g. help and more) combined with vocalizations. He was able to use distal gestures, such as pointing and showing objects that were out of his reach. He was able to appropriately initiate social interactions, share affective states, and coordinate gaze, facial expressions, gestures and vocalizations.

His receptive vocabulary skills were equivalent to a 21-month-old child, as measured by the PPVT-IV. Kevin was able to comprehend simple verbal instructions, mainly when accompanied by contextual cues. He also comprehended basic manual signs, such as “please”, “help”, and “want”. Kevin’s mother and his school staff were reported to sporadically use some manual signs accompanied by speech when communicating with him. This was typically done as a repair strategy when he failed to comply with verbal requests. No aided systems of communication were used at home prior to this investigation. School records, on the other hand, indicated that the school staff used picture communication symbols for enhancing speech comprehension during transitions and for indicating activity choices. Kevin, however, was not reported to use these symbols for expressive communication purposes.

Kevin had a limited attention span, presented constant repetitive behaviors and unusual sensory interests. He would frequently engage in finger flickering and hand-flapping behaviors. He was fascinated by airplanes an enjoyed playing on the computer, watching TV, listening to music and skating. He was never observed engaging in symbolic play activities.

**Caregiver Participants**

The four caregivers involved in this study were the biological mothers of the child participants. They ranged in age from 29 to 35 years old at the onset of the study. Two caregivers had completed high school, one had one year of college, and the other had earned a master’s degree. One caregiver was an undergraduate student, another was unemployed, one was a healthcare professional and the fourth worked at a childcare agency. Two were married and the other two were single parents. Two of the caregivers had two other children and one had one other daughter. One caregiver was African American and the others were Caucasian.
Table 2.2

*Caregiver Characteristics*

<table>
<thead>
<tr>
<th></th>
<th>Barney’s mother</th>
<th>Charlie’s mother</th>
<th>Jason’s mother</th>
<th>Kevin’s mother</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>35</td>
<td>31</td>
<td>30</td>
<td>29</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td>Caucasian</td>
<td>Caucasian</td>
<td>African-American</td>
<td>Caucasian</td>
</tr>
<tr>
<td><strong>Education level</strong></td>
<td>14</td>
<td>12</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td>Mental health therapist</td>
<td>Undergraduate student</td>
<td>Unemployed</td>
<td>Childcare agency worker</td>
</tr>
<tr>
<td><strong>Number of children</strong></td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Note 1: Number of years of formal education completed

**Interventionist**

The interventionist was a 31-year old doctoral candidate in Special Education. She was Latin and had two years of experience in providing AAC interventions for individuals with communication impairments. Three Master’s level students in Special Education, two in Speech Pathology and one undergraduate student worked as research assistants. They accompanied the interventionist in 30% of the sessions and were responsible for data coding.

**Setting**

All baseline, intervention and generalization sessions took place in the dyad’s homes. The setting was determined by the nature of the routines and the objects, materials and equipment that pertained to each activity. All dyads selected activities that typically occurred in the kitchen or living room settings. No modifications were made to objects, equipment or any material that belonged to each routine context. All participants used the kitchen/dining room as one of the settings in the study. Some of Barney’s sessions took place in his room, some of Jason’s took place in his bathroom, and Kevin additionally used the living room and his mother’s bedroom. Barney’s sister was frequently present during his sessions, while his brother rarely participated. Charlie’s siblings were present in the majority of his sessions. Jason’s sister was sometimes
present during his interactions with his mother. Kevin and his caregiver did all sessions alone. To maintain consistency across dyads, only the primary caregiver’s interactions with the participant were coded for data analysis.

**Materials**

The child’s preferred toys, foods or any materials or equipments involved in the routines were used in the sessions. Play equipments included a computer and a DVD player. Play materials used were puzzles, balloons, playdough shapes, paper, computer games, VHS/DVD tapes, and different colors of playdough, Legos, and crayons. One of the routines additionally involved the kitchen’s sink, a bottle of liquid/bar soap and a cloth or paper towel, while another one included some of the child’s clothes, such as shorts, pants and diapers. Various snack and dinner items, such utensils, plates, cups, cookies, cracker, cakes, juice, water, potatoes, corn, chicken, and vegetables were also made available during mealtime.

All participants used visual-graphic communication systems, such as communication cards, boards, or books. The symbols included in these devices were PCS pictures and photographs (from 3x3 to 5x5 inches) that represented the vocabulary used during the interactions. These were representations of nouns (e.g. food items, toys and soap), verbs (e.g. want) and modifiers (e.g. more) used by the dyad. The nouns were typically very iconic, with the symbol being very visually similar to its referent (Wilkinson & McIlvane, 2002). The verbs and modifiers, on the other hand, were less iconic. A picture of two hands reaching for a red block, for example, represented the word “want”. Less iconic symbols, such as a line drawing of a person manually signing words, like “help”, “more” and “please” were also used.

The symbols relating to the hand-washing routine were displayed in a 15 x 5-inch board, which was attached to the wall in front of each family’s kitchen sink. Mealtime, dressing, play dough, coloring, puzzles and Legos routines used picture cards, which were typically kept in a plastic bag or attached to a board on the refrigerator door. The four participants also had mealtime symbols displayed on 17 x 11-inch placemats. Additionally, Kevin used a 4-page communication book with detachable pictures (attached with Velcro) during TV and computer routines.
Table 2.3
Participants’ Settings and Materials

<table>
<thead>
<tr>
<th></th>
<th>Barney</th>
<th>Charlie</th>
<th>Jason</th>
<th>Kevin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting</td>
<td>Kitchen, dining room, and bedroom.</td>
<td>Kitchen and dining area.</td>
<td>Kitchen, bathroom and dining area.</td>
<td>Mother’s bedroom, his bedroom, living room and kitchen</td>
</tr>
<tr>
<td>Material</td>
<td>Soap, towel, Legos, playdough, playdough shapes, crayons, paper, various food items and utensils.</td>
<td>Soap, towel, playdough, playdough shapes, puzzles, various food items and utensils.</td>
<td>Soap, towel, balloons, crayons, puzzles, various food items and utensils.</td>
<td>Clothes, computer games, computer, VHS tapes, DVD disks, TV, various food items and utensils.</td>
</tr>
</tbody>
</table>

Experimental Design

A multiple baseline across routines (Barlow & Hersen, 1984) with replications across participants was used to evaluate the effects of the intervention. This type of design was chosen because:

1. It allowed for continuous observation of changes in behavior throughout intervention;
2. It facilitated the visual inspection of trends in behavior and response patterns;
3. It facilitated modifications in procedures to fit each participant’s needs without affecting the validity of the study;
4. The visual inspection allowed the detection of clinically significant gains, regardless of statistical significance.

The study involved initially teaching the parent to use the instructional techniques during two home routines and then evaluating the effects of this procedure on the child’s communication outcomes. In other words, two classes of independent variables were identified in this study. Initially, the caregiver-teaching program functioned as the first independent
variable. The effects of this program were directly measured by the caregivers’ use of the naturalistic teaching strategies and indirectly measured through the changes in child’s communication outcomes. Therefore, following the caregivers’ training, the use of the strategies functioned as the independent variable for the child’s behavior. The caregivers’ ability to generalize the strategies to untrained routines and the children’s communication outcomes were also assessed during generalization probes.

**Caregiver Naturalistic Strategies**

Environmental Arrangement, Mand, Mand/Comment with the Augmentative System, and Model were identified as naturalistic strategies. Definitions of these strategies are present in Table 2.4.

**Table 2.4**

*Caregiver Naturalistic Strategies*

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Arrangement</td>
<td>The caregiver places the aided device within the child’s reach and places desired objects within the child’s sight, but out of reach; provides insufficient components of an element essential for completing a task; and/or stands between the child and a desired object.</td>
</tr>
<tr>
<td>Mand</td>
<td>Considering the child’s focus of attention, the caregiver verbally mands a response from the child or verbally asks the child a question.</td>
</tr>
<tr>
<td>Mand/Comment</td>
<td>The caregiver uses the communication device to make comments, ask questions, or mand responses from the child. The caregiver simultaneously uses verbal language while using the device to communicate with the child.</td>
</tr>
<tr>
<td>Model</td>
<td>The caregiver physically guides the child’s hand in using the system. This is accompanied by caregiver verbal comment, question or mand.</td>
</tr>
</tbody>
</table>
**Child Communicative Response**

The frequency of the children’s modes of communication (verbal/vocal, augmentative system, or gestures/manual signs), turn taking (initiations and responses to interactions), and imitative responses during the interaction were calculated. Definitions of these communicative responses are provided in Table 2.5 and Table 2.6.

**Table 2.5**

*Child Communicative Response Type*

<table>
<thead>
<tr>
<th>Response Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication Turn</td>
<td>A communication turn will be considered when the child initiates an interaction with the caregiver with no prior caregiver cue or responds to the caregiver’s request or command using a gesture/manual sign, a verbalization/vocalization, and/or the aided communication device</td>
</tr>
<tr>
<td>Imitative Response</td>
<td>The child contingently imitates the caregiver’s gestural/manual, verbal/vocal or aided communication behavior.</td>
</tr>
</tbody>
</table>

**Table 2.6**

*Child Communicative Response Mode*

<table>
<thead>
<tr>
<th>Response Mode</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aided System</td>
<td>The child uses the communication device to initiate an interaction, respond, or imitate the caregiver’s requests, instructions or questions;</td>
</tr>
<tr>
<td>Gestures/Manual signs</td>
<td>The child uses manual signs or gestures to initiate an interaction, respond, or imitate the caregiver’s requests, instructions or questions;</td>
</tr>
<tr>
<td>Verbalizations/Vocalizations</td>
<td>The child uses vocalizations or verbalizations to initiate an interaction, respond, or imitate the caregiver’s requests, instructions or questions;</td>
</tr>
</tbody>
</table>
Procedures

The current study was conducted in five phases: (1) Phase 1: Assessment; (2) Phase 2: Baseline; (3) Phase 3: Caregiver Teaching; (4) Phase 4: Caregiver Intervention; (5) Phase 5: Follow-up.

**Phase 1: Assessment.** A child assessment, a caregiver interview, and a review of the children’s medical and/or school records were used to identify the child’s communication strengths, needs and interests. The CARS (Schopler, et al., 1988) was applied to measure the child's level of autism and the PPVT-IV (Dunn & Dunn., 1997) and EOWPVT (Gardner, 2000) or PLS-IV (Zimmerman et al., 2002) were used to evaluate the child’s expressive and receptive language skills. Information from these various sources was used to identify communication outcomes for each child. Table 2.7 provides information on each child communication outcomes.

Table 2.7

*Child Communication Outcomes*

<table>
<thead>
<tr>
<th>Child</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barney</td>
<td>Increase the frequency of initiations and responses using the picture communication symbols, gestures/manual signs or verbalizations.</td>
</tr>
<tr>
<td>Charlie</td>
<td>Increase frequency of initiations and responses using the picture communication symbols, gestures/manual signs or verbalizations</td>
</tr>
<tr>
<td>Jason</td>
<td>Increase frequency of initiations and responses using the picture communication symbols, gestures/manual signs or verbalizations</td>
</tr>
<tr>
<td>Kevin</td>
<td>Increase frequency in the use of picture communication symbols when initiating or responding to caregiver.</td>
</tr>
</tbody>
</table>
During the assessment phase, the interventionist and the caregiver defined the routines where the intervention and generalization sessions would occur. The routines chosen for intervention and generalization probes were based on the dyad’s interests, availability and communication opportunities. In total, from 4 to 5 routines were chosen for each child (See Table 2.8).

Barney’s caregiver indicated that some of Barney’s favorite play routines were: playing with Legos, coloring, playing with play dough, and outside in the sandbox. She mentioned that he typically played in the sandbox by himself and that she would prefer working with him in an indoor play activity. This would also allow her to look after her other 2 children in case they did not want to participate in the outdoor activity. The selection of the caregiving routines were based on Barney’s usual afternoon schedule. When he finished playing, his mother would direct him to wash his hands before having the afternoon snack.

Charlie’s caregiver suggested that her son enjoyed completing puzzles and playing outside with his two siblings. Charlie also exhibited a great interest in animals. He had various stuffed animals on his bed and pictures of animals on his bedroom wall. Considering Charlie’s interest in this theme, the interventionist suggested a play dough activity where animal shapes would be incorporated. The caregiver enjoyed the idea, especially since Charlie typically played with play dough in school. This activity would also provide multiple communication opportunities for the child, since he would need assistance in making different animal shapes, opening the play dough recipients, and asking for different play dough colors. The selection of the snack and hand washing routines were based on Charlie and his sibling’s afternoon schedule. When the three children arrived from school, they typically washed their hands and had something to eat.

Jason’s mother suggested that her son enjoyed coloring books, completing puzzles, inflating balloons, and watching TV. Since the TV routine seemed to provide limited communication opportunities, the first three routines were incorporated in the study. Considering that Jason typically had snack in the afternoon and his mother washed his hands prior to this routine, these two activities were additionally selected.

Kevin’s mother suggested that her son rarely engaged in typical play activities, such as puzzles, balls, or card games. She indicated, however, that he was fascinated by airplanes, he enjoyed watching airplane movies, and playing on the computer (especially if airplane games
were involved). She usually assisted him in the computer activities, by turning on the monitor and selecting the activities he wanted to play with. Additionally, she helped him set up the TV to play his favorite DVD/VHS tapes. In this context, the interventionist suggested the production of a communication book containing the characters and elements found in the computer games and DVD/VHS materials. Considering that the sessions typically occurred in the evening, when Kevin had dinner and then got ready for bed, the interventionist suggested working on the mealtime and dressing routines.

Considering the Routine-Based-Intervention framework described by Woods and colleagues (2004), these activities were grouped in two general classes of routines: caregiving and play. The routines that were structurally and functionally similar were placed in the same routine class. For example, dressing, mealtime, and handwashing belonged to the caregiving routine class, whereas playing with playdough, balloons, puzzles, and computer were regarded as play routines.

During this phase, the caregiver and the interventionist also selected the types of communication devices to be used by the child participant. The selection of the device was based on the child’s previous exposure to a similar device, the nature of the routine, and the dyad’s preferences. The AAC selection technique (Beukelman & Mirenda, 1998) also was determined considering the child’s motor abilities and the communication function of each utterance. The caregivers involved in this study taught their sons to make requests by physically exchanging the picture cards for desired items. When making comments, such as “I like this”, the child participants were encouraged to only touch to the symbols in the system. Barney and Jason, for example, had some picture cards available in the home from previous or recent AAC intervention attempts. Charlie had some exposure to picture communication cards in previous intervention programs and Kevin sporadically used picture cards at school. In these cases, the children used the cards and symbols currently available in the home and/or similar cards produced by the interventionist. These were typically 3 x 3 or 5 x 5 inch laminated cards containing a photograph or PCS symbols of the vocabulary words used in routines. These cards additionally included the written label of each symbol.

The use of picture cards, however, did not seem feasible for all of the routines. Due to space limitations, the cards related to the handwashing activity could not be placed on the sink where the routine was performed. In this case, the interventionist suggested the use of a
laminated picture board attached to the wall in front of the sink. In addition to the picture cards, Barney, Charlie and Jason, therefore, also used a 15 x 5-inch communication board that contained 5 detachable pictures for the handwashing routine.

For mealtime routines, the interventionist produced 17 x 11-inch placemats for the four child participants. These laminated mats contained nondetachable pictures (with written labels) containing core vocabulary symbols (Beukelman & Mirenda, 1998), such as commonly used verbs (e.g. want), modifiers (e.g. more), and ready-made sentences, such as “I like this”, “it’s hot”, and “all done”. On one corner of the mats, a strip of Velcro was made available for the caregiver to attach the picture symbols used during the routines. Kevin’s placemat contained approximately 15 nondetachable pictures, while the other 3 participants had approximately 7 nondetachable pictures. Considering that Barney, Charlie, and Jason’s siblings would typically be present during the sessions, the interventionist produced 5 additional placemats for them to use. The siblings’ placemats contained the same symbols as the one used by the child participant.

In the initial baseline sessions, Kevin’s mother reported difficulty in manipulating and organizing the large number of communication cards available during computer and TV activities. Communication books were, therefore, additionally produced to facilitate the use of the symbols. Four pages containing approximately 10 detachable picture cards composed the 2 communication books used in the study. Each page contained symbols that referred to a different computer game or films.

Table 2.8 provides description of the selected routines for intervention and generalization probes, AAC devices used, and the selection techniques for each child participant.

<table>
<thead>
<tr>
<th>Target Routine</th>
<th>Barney</th>
<th>Charlie</th>
<th>Jason</th>
<th>Kevin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Play: Legos and playdough</td>
<td>Play: Playdough</td>
<td>Play: Puzzle and coloring</td>
<td>Play: Computer games</td>
<td></td>
</tr>
<tr>
<td>Caregiving: snack</td>
<td>Caregiving: snack</td>
<td>Caregiving: snack</td>
<td>Caregiving: dinner</td>
<td></td>
</tr>
</tbody>
</table>
Phase 2: Baseline. Following the assessment phase, baseline observations of the dyad interaction within the selected routines occurred. In these episodes, the caregiver was given the augmentative system and instructed to interact with her child as she typically did. This was conducted both for target and generalization routines. Instructions on how to conduct each activity or suggestions on how to incorporate the picture systems were not provided. The sessions had an average duration of 10 minutes.

Phase 3: Caregiver teaching. Intervention in the first target routine began when a stable trend was visually detected in the caregiver’s use of 2 of the 4 teaching strategies. A stable trend was defined as a fairly constant level of variability between data points or a lack of upward or downward tendency or drift in the set of data collected (Best & Kahn, 2006). While intervention began in the first target routine, the 3 other routines were kept in baseline condition. When changes in the caregiver’s use of 2 strategies were visually detected in three consecutive sessions of the first target routine, the intervention began on the second target routine. Routines selected as generalization probes did not receive treatment.

In the first teaching session, the researcher and the parent discussed the definitions and utilization of the 4 teaching strategies. The parent received a handout with a full description of

<table>
<thead>
<tr>
<th></th>
<th>Barney</th>
<th>Charlie</th>
<th>Jason</th>
<th>Kevin</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Generalization routines</strong></td>
<td>Play: coloring</td>
<td>Play: puzzle</td>
<td>Play: balloons</td>
<td>Play: TV</td>
</tr>
<tr>
<td></td>
<td>Caregiving: handwashing</td>
<td>Caregiving: handwashing</td>
<td>Caregiving: handwashing</td>
<td>Caregiving: dressing</td>
</tr>
<tr>
<td><strong>AAC Devices</strong></td>
<td>Communication cards, board, and a placemat</td>
<td>Communication cards, board, and a placemat</td>
<td>Communication cards, board, and a placemat</td>
<td>Communication cards, books, and a placemat</td>
</tr>
<tr>
<td><strong>Selection technique</strong></td>
<td>Picture exchange and pointing</td>
<td>Picture exchange and pointing</td>
<td>Picture exchange and pointing</td>
<td>Picture exchange and pointing</td>
</tr>
</tbody>
</table>
each strategy and was requested to provide two examples of its use during typical play routines. Next, the researcher gave the parent a “cheat-sheet” with a summary of the techniques and asked the mother to play her own role while the researcher played the child’s part in the target activity (see Appendix C for parent training materials). Following the role-play, the child was brought to the setting and the parent was instructed to interact with him using the strategies learned. During this initial session, the researcher coached the parent throughout the interaction. This helped the parent identify episodes where the use of the strategy would be appropriate and modeling its use with the child. For example, if the child requested a snack item during a routine, the caregiver was instructed to provide insufficient amount of the food item (Environmental Arrangement) in order to increase the child’s probability in requesting more.

At the end of the routine, the experimenter provided further feedback and answered questions raised by the parent. The mothers typically asked about where to place the AAC system during the interaction and the amount of AAC symbols to use in the routine. During this session, the research assistant observed the researcher and the parent and completed a treatment fidelity checklist containing each step of the teaching protocol (see Appendix B). The teaching sessions were not videotaped and data on caregiver and child variables were not collected.

**Phase 4: Caregiver intervention.** In subsequent sessions, the researcher provided the mother with the communication system to be used in the routine and asked her to interact with her child using the teaching procedures. In these episodes, the researcher did not coach or model the use of the strategies during the interaction, but stayed behind the camera videotaping. After the routine had terminated, the researcher offered feedback to the parent, answered questions and provided suggestions for subsequent sessions. The caregiver intervention sessions typically lasted from 3 to 15 minutes.

If visual inspection of coded data indicated that parental use of at least two of the strategies returned to baseline levels during two consecutive sessions, a new teaching session took place. The four caregiver participants met this criterion throughout the study and were not required to undergo caregiver treatment more than once.

The caregiver intervention phase of the study terminated when the visual inspection of the data indicated that two of the four caregiver teaching strategies were above baseline levels in a stable or ascending trend for the target routines. All home visits occurred twice a week and had an average duration of 60 minutes.
Phase 5: Follow-up. One month following the termination of the study, the researcher returned to the dyad’s homes to evaluate the maintenance of the caregivers’ strategy use and the children’s responses. In these visits, the researcher asked the caregiver to interact with the child in the trained and untrained routines. The researcher videotaped the sessions, but did not coach, model or provide feedback to the caregivers regarding strategy use. From 3 to 4 home visits were scheduled. All visits had an average duration of 60 minutes.

During the first follow-up session, the researcher gave each mother a caregiver survey and a parent satisfaction questionnaire (Appendix D) and instructed them to complete the forms by the last follow-up visit. In this final visit, the caregiver showed the completed forms to the researcher and discussed each of the answers. These sessions were videotaped and had an average duration of 30 minutes. The first instrument (caregiver survey) was adapted from a survey elaborated by Angelo (2000). This instrument included questions concerning parent perception of the child’s AAC use. The second tool was a parent satisfaction form elaborated by the researcher. This instrument contained questions pertaining caregiver perception of the procedures applied during the intervention.

Data Collection

All baseline, intervention and generalization sessions were videotaped and subsequently coded for caregiver’s use of the teaching strategies and child’s responses. Following each home visit, a research assistant viewed the tape and selected a 3-minute segment for analysis. This length of interaction episode has been previously used in the research literature (e.g. Woods et al., 2004) and heeded as appropriate for sampling teaching moments between caregivers and children. The segment selection process was done using a Likert scale, where the frequency of caregiver responsiveness was rated for each minute of interaction. Caregiver responsiveness was defined as episodes where the caregiver used eye gazes, verbalizations and gestures to request items, ask questions, make comments or share affective states with the child. The rates were as following: 1: the caregiver did not interact with the child; 2 the caregiver interacted with the child in at least one occasion; 3: the caregiver interacted with the child from 2 to 3 times; 4 the caregiver interacted from 4 to 6 times; and 5: more than 6 interaction episodes were observed. The first 3-consecutive-minute segment where the caregiver received the highest interaction score was chosen for analysis. The research assistants then coded caregiver and child behavior for selected 3-minute segments. The segment selection scale is available in the Appendix B.
Data Analysis.

Treatment outcomes were evaluated through visual inspection of the data displayed in the multiple baseline graphs. Changes in the trend or slope between baseline and treatment in the anticipated direction indicated effective outcomes. Additionally, the Percentage of Nonoverlapping Data (PND; Scruggs, Mastropieri, and Casto, 1987) was used to evaluate the effect size or the degree of effectiveness of the intervention. PND scores have been used to compute treatment efficacy across studies using single-subject research design methodologies (Algozzine Browder, Karvonen; Test and Wood, 2001; Xin, Grasso, Dipipi-Hoy and Jitendra, 2005). Causton-Theoharis, Malmgren and Kimber (2005) have additionally used this nonparametric procedure in a single-subject multiple-baseline study.

PND scores are calculated by computing the proportion of treatment data points that exceed preceding baseline points in the anticipated direction. For example, an intervention in which 70% of the data points in the treatment phase exceed the highest point in the baseline phase is given a PND of 70; if 54% is exceeded, the PND is 54. Comparisons of PND scores with visual inspection suggest that a PND of 90 or above indicates an effective treatment, 70-89 indicates moderately effective, 50-69 indicates mildly effective, and 49 or below indicates an ineffective treatment (Scruggs et al., 1986).

Social Validity

At the conclusion of the study, the caregivers completed 2 questionnaires: one to evaluate the effectiveness of the AAC intervention on child outcomes and one to measure caregiver satisfaction with the treatment. Theses instruments included from 5 to 10 questions rated on Likert scales. The questions included in these instruments are available in Appendix D.

Treatment Fidelity

Prior to the onset of the investigation, the research assistants discussed with the researcher the definitions and examples of the four naturalistic teaching strategies to be used in the study. Then, the researcher discussed the caregiver training protocol with the assistants (Appendix C) and handed them a copy of the treatment fidelity checklists Model 1 and Model 2 (Appendix B). Next, the researcher instructed the assistants to read the checklists and ask questions, if needed.
In order to verify if the researcher was implementing the intervention as described in the caregiver training protocol, the research assistants completed one treatment fidelity checklist (Model 1) in every caregiver teaching session (phase 3) and one treatment fidelity checklist (Model 2) in 30% of the caregiver intervention sessions (phase 4). These checklists were completed during the home visits. In total, the research assistants completed 8 checklists for the caregiver teaching sessions (phase 3) and 54 checklists for the caregiver intervention sessions (phase 4). Results from this assessment showed that the researcher followed the steps in the protocols with 100% accuracy.

Reliability

Prior to the onset of the investigation, the research assistants discussed with the researcher the definitions and examples of each caregiver and child variables and then practiced independently coding 3-minute segments of interactions on a mock tape. The coded data sheets were compared on a point-by-point basis for both caregiver and child variables. An agreement was scored when both coders recorded the occurrence of the same response within the same time interval. A disagreement was scored when the responses were registered in different time intervals and/or differed in category type. The percent agreement was calculated using an exact agreement procedure, where the number of agreements is divided by the number of agreements plus disagreements and then multiplied by 100 (Koorland & Westling, 1981). This training process continued until interobserver agreement of each behavior reached a criterion level of 80% for 3 consecutive sessions.

Following the reliability training, the research assistants were requested to view and code the baseline and intervention sessions from the dyads in the study. To measure reliability, the researcher independently coded 30% of the sessions (including baseline, intervention and follow-up phases) coded by the assistants throughout the study. The same interrater agreement calculation as the one described during the reliability practice was made. To correct for chance agreement, Kappa scores were calculated as a second measure of reliability.
Table 2.9

*Interobserver Agreement*

<table>
<thead>
<tr>
<th>Caregiver strategy</th>
<th>Interobserver Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Arrangement</td>
<td>87% (39-100)</td>
</tr>
<tr>
<td>Mands/Questions</td>
<td>70% (44 -96)</td>
</tr>
<tr>
<td>Questions/ Comments with the augmentative system</td>
<td>80% (42 -100)</td>
</tr>
<tr>
<td>Model with the augmentative system</td>
<td>95% (50 – 100)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Child Outcomes</th>
<th>Interobserver Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication turn (initiations and responses)</td>
<td>79% (33 – 96)</td>
</tr>
<tr>
<td>Imitative responses</td>
<td>85% (38 – 100)</td>
</tr>
<tr>
<td>Verbalizations/vocalizations</td>
<td>80% (41 – 100)</td>
</tr>
<tr>
<td>Gestures</td>
<td>83% (17 – 100)</td>
</tr>
<tr>
<td>AAC</td>
<td>84% (29 – 100)</td>
</tr>
</tbody>
</table>
CHAPTER 3

RESULTS

The purpose of this research was to investigate the effects of a parent-implemented naturalistic intervention on the communication outcomes of children with autism using augmentative communication devices. Specifically, the researcher focused on the following questions:

(1) Can caregivers learn to implement naturalistic teaching strategies using visual-graphic systems of communication during home routines?

(2) What changes in the children’s communication modes (vocalization/verbalization; gestures/signs; and aided systems), frequency of communication turns (initiations and responses), and imitative responses are observed with the implementation of this intervention?

(3) How does the caregiver evaluate this intervention program?

(4) Does the caregiver perceive any changes in the child’s communication abilities following the intervention?

The results from the child-caregiver coding data address the first two questions. The responses to questions 3 and 4 are derived from a satisfaction questionnaire and an interview conducted with the caregivers at the end of the study. The effects of the teaching package on the caregiver response and the effects of the caregiver's use of the strategies in relation to the child's responses are discussed for each child.

Social validity measures are addressed in questions 3 and 4. Results from this section are displayed in Tables 3.5 and 3.6 and organized into two major sections: 1) caregiver perception of the intervention package and 2) caregiver perceptions of child communication gains.
Barney

1. The effects of the teaching package on caregiver response

The frequency of Barney’s caregiver use of Environmental Arrangement, Mands, Mands/Comments using the AAC system, and Model is displayed in Figures 3.1 to 3.4. The data displayed in these graphs represent the frequency of caregiver strategy use during the baseline, intervention, and follow-up sessions of the study during the three minutes of the session that were coded for data analysis purposes. The decision to initiate intervention in the first routine was based on the stable trends detected in the caregiver’s use of Environmental Arrangement and Model (Figures 3.1 and 3.4). When Barney’s caregiver use of both of these strategies was above baseline levels in stable or ascending trends, the intervention began in the target caregiving routine (snack). The intervention terminated when an ascending or stable trends were detected for the use of Environmental Arrangement and Model in the target play routine and Mands/Comment using the AAC and Environmental Arrangement in the target caregiving routine.
Figure 3.1. Frequency of Barney’s Caregiver Use of Environmental Arrangement across Routines

Figure 3.2 Barney’s Caregiver Use of Mands across Routines
Figure 3.3 Barney’s Caregiver Use of Mands/Comments using the Augmentative System across Routines

Figure 3.4 Barney’s Caregiver use of Models across Routines
Post-intervention effects were observed by increases in caregiver strategy use above baseline levels for Environmental Arrangement (EA), Mands/Comment using the AAC (MAAC), and Model (Mo) during the play dough, Lego and snack sessions. During these target routines, the caregiver typically pointed to each picture symbol and verbally asked Barney if he wanted specific play dough shapes, different colors of Lego or food items (MAAC). If he responded, she would usually provide him with insufficient amount of the desired item, such as only one piece of Lego during play or one cookie during snack (EA). When he failed to respond to her request through gestures and/or vocalizations/verbalizations, she physically prompted him to use the system to respond (Mo). Barney’s mother continued using these 3 strategies above baseline levels in at least one target routine during the follow-up phase of the study. Interestingly, as the use of these 3 strategies increased throughout intervention, a decreasing trend was detected in the use of Mands for these same target routines following treatment and during follow-up.

In the generalization probes, ascending trends were observed for the use of Environmental Arrangement and Mands/Comment using the AAC during the untrained coloring sessions, while relatively stable trends were shown for the use of these strategies in the untrained hand washing routine. Despite some sporadic uses of Model above baseline levels throughout these two untrained routines, no clear trend for strategy use was established. Following the termination of the treatment, the caregiver continued using Mands/Comment using the AAC above baseline levels during coloring. The use of Environmental Arrangement and Model, however, was not maintained above baseline levels in both generalization routines at follow-up. As in the trained sessions, the use of Mands during both generalization routines decreased during intervention and follow-up.

2. The effects of caregiver strategy use on child response type and mode

The frequency of Barney’s Communicative Turn-Taking behaviors (initiations and responses) and Imitative Response is displayed in Figures 3.5 and 3.6. The frequency of Barney’s responses using the AAC system, verbalizations/vocalizations, and gestures/manual signs, are displayed in Figures 3.7 to 3.9. The data displayed in these graphs represent the frequency of child responses during the three minutes of the session that were coded for data analysis purposes in baseline, intervention, and follow-up sessions of the study.
Barney: Communication turn

![Barney's Communication Turn across Routines](image)

**Figure 3.5.** Barney’s Communication Turn across Routines

Barney: Imitative Response

![Barney's Imitative Responses across Routines](image)

**Figure 3.6.** Barney’s Imitative Responses across Routines
Figure 3.7 Barney’s AAC Use across Routines

Figure 3.8 Barney’s Vocalizations and Verbalizations across Routines
The frequency of Barney’s turn-taking behavior following caregiver training increased during the play dough/Lego (target routines) and coloring (generalization routine) activities. These trends were kept above baseline levels throughout the intervention and follow-up phases of the investigation. Barney presented some timid gains in the use of communication turns during the intervention phase of snack (target caregiving routine), but returned to baseline levels at follow-up. No differences in the use of communication turns were detected in the hand washing sessions (untrained caregiving routine) throughout the three phases of the study.

Barney used imitative responses with greater frequencies during the initial sessions of the target play routine when compared to baseline conditions. These were mostly echolalic responses to his mother’s verbalizations. This trend gradually decreased in the following sessions and returned to baseline levels one month subsequent to the termination of the study. Likewise, the use of imitative responses during snack was relatively below baseline levels during the intervention and follow-up phases of the investigation. A stable trend was detected across the three phases of the hand washing sessions.
In terms of child communication modes, Barney presented gains in the use of the AAC system, verbal/vocal responses, and the use of gestures in at least one target routine following intervention. One month following the termination of the treatment, Barney continued using the AAC system and gestures above baseline levels in at least one target routine. The rate of verbal/vocal responses, however, decreased in both of these activities during follow-up.

Barney showed gains in the use of gestures/manual signs and vocal/verbal responses in the coloring routine (generalization play probe) following intervention in the target play activities. The use of these response modes was kept above baseline levels one month following the termination of the treatment. No systematic changes in the child’s communication modes were observed during the hand washing routine (generalization probes).

Charlie

1. The effects of the teaching package on caregiver response

The frequency of Charlie’s caregiver use of Environmental Arrangement, Mands, Mands/Comments using the AAC system, and Model is displayed in Figures 3.10 to 3.13. The data displayed in these graphs represent the frequency of caregiver strategy use during the baseline, intervention, and follow-up sessions of the study during the three minutes of the session that were coded for data analysis purposes. To initiate intervention in the first routine, the researcher considered the stable trends detected in the use of Model and Environmental Arrangement during the baseline phase. When Charlie’s caregiver use of both of these strategies were above baseline levels in a stable or ascending trends, the intervention began in the target caregiving routine (snack). The intervention terminated when an ascending or stable trends were detected for the use Mands/Comment using the AAC (Figure 3.12) and Environmental Arrangement (Figure 3.10) in the both target routines.
Charlie: Caregiver Use of Environmental Arrangement

![Graph showing frequency of Charlie's Caregiver Use of Environmental Arrangement across routines and sessions.](image)

*Figure 3.10. Frequency of Charlie’s Caregiver Use of Environmental Arrangement*

Charlie: Caregiver Use of Mands

![Graph showing frequency of Charlie's Caregiver Use of Mands across routines and sessions.](image)

*Figure 3.11 Charlie’s Caregiver Use of Mands across Routines*
Charlie: Caregiver use of Mands/Comments using AAC

Figure 3.12 Charlie’s Caregiver Use of Mands/Comments using the Augmentative System

Charlie: Caregiver Use of Model

Figure 3.13 Charlie’s Caregiver Use of Models across Routines
Treatment effects were demonstrated by increase in caregiver use of Environmental Arrangement (EA) and Mands/Comment using the AAC (MAAC) for the play dough and snack routines following caregiver teaching. Charlie’s mother continued using these 2 strategies above baseline levels in both target routines one month following the termination of the treatment. During the play dough sessions, the caregiver would typically point to the different play dough colors on the AAC system and ask Charlie to indicate what color he wanted to play with (MAAC). She would additionally ask him to point to the picture of the animal on the AAC system he wanted her to make (MAAC). When she made the figure he indicated, she would keep it out of his reach until he requested it using the AAC system, gestures of vocal/verbal responses (EA). In the snack routines, the caregiver usually augmented her speech by pointing to the pictures on the system (MAAC) or provided Charlie with small amounts of food items at a time (EA).

As the use of Environmental Arrangement and Mands/Comment using the AAC increased, a decreasing trend in the use of Mands was detected during the intervention and follow-up phases of the snack routine. With the exception of two outliers detected during intervention of the play dough routine, no consistent trend for caregiver use of Mands was observed following treatment. On the other hand, Charlie’s caregiver increased the use of Mands above baseline levels following the termination of the treatment in the play dough routine. These were episodes where she verbally requested Charlie to indicate what he wanted her to make using the play dough. In these sessions she used the AAC system less frequently to augment her speech. No consistent changes in the use of Model were observed during the intervention and follow-up phases of the play dough and snack routines.

Subsequent to intervention in the target play routine, Charlie’s mother presented gains in the use of Environmental Arrangement (EA) and Mands (M) during puzzle routine (untrained play routine). During this activity, she would typically provide him with only one or two pieces of the puzzle at a time (EA) and verbally ask him if he wanted more (M). Despite her gains in the use of Environmental Arrangement and Mands, no changes were detected in the use of Model and Mands/Comment using the AAC in this routine. Likewise, the use of these two strategies also did not increase in the hand washing routine following intervention in the target snack routine. One month following the termination of the treatment, the frequency of caregiver use of Environmental Arrangement and Mandss/Comments using the AAC were observed to be above
baseline levels in at least one untrained routine. Contrastingly, the frequency of caregiver use of Mands reduced in both untrained routines following the termination of the intervention. No consistent changes were observed in the mother’s use of Model during this phase.

2. The effects of caregiver strategy use on child response type and mode

The frequency of Charlie’s Communicative Turn-Taking behaviors (initiations and responses) and Imitative Response is displayed in Figures 3.14 and 3.15. The frequency of Charlie’s responses using the AAC system, verbalizations/vocalizations, and gestures/manual signs, are displayed in Figures 3.16 to 3.18. The data displayed in these graphs represent the frequency of child responses during the baseline, intervention, and follow-up sessions of the study during the 3 minutes of data collection.

![Charlie: Communication Turn across Routines](image)

*Figure 3.14. Charlie’s Communication Turn across Routines.*
Charlie: Imitative Responses

Charlie: AAC Use

Figure 3.15. Charlie’s Imitative Responses across Routines

Figure 3.16. Charlie’s AAC Use across Routines
Charlie: Verbalizations and Vocalizations

Play Routines

Baseline

Intervention

Follow-up

Caregiving Routines

Charlie: Gestures and Manual Signs

Play Routines

Baseline

Intervention

Follow-up

Caregiving Routines

Figure 3.17 Charlie’s Vocalizations and Verbalizations across Routines

Figure 3.18. Charlie’s Use of Gestures and Manual Signs across Routines
Following caregiver intervention the rate of Charlie’s communication turn increased across both trained and untrained routines. He additionally presented gains in the use of imitative responses in the play routines (play dough and puzzle), subsequent to intervention. At follow-up, this trend was kept above baseline levels for the play dough activity (target routine), but not for puzzle. Interestingly, he showed an increase in imitative responses in the last follow-up session of the untrained caregiving routine. These were mostly vocal/verbal imitations of his mother’s verbalizations during hand-washing.

In terms of communication modes, Charlie presented gains in the use of the AAC system and verbal/vocal responses in at least one target and one untrained routine following intervention. During play dough, Charlie would usually use the AAC system to request his mother to make different animals shapes. When this happened, the caregiver would say the name of the animal on the picture card and ask him to repeat her verbal prompt. Charlie typically repeated the name of the animal with clarity. Likewise, during the snack routine, as he handed her the AAC symbols to request snack items, she would usually prompt him to verbalize the name of the item on the picture card. The child’s use of the AAC system was maintained above baseline levels for snack and both play routines. His rate of vocal/verbal responses were maintained above baseline levels during play dough and both caregiving routines. No systematic changes were observed in Charlie’s use of gestures or manual responses across these activities.

Jason

1. The effects of the teaching package on caregiver response

The frequency of Jason’s caregiver use of Environmental Arrangement, Mands, Mands/Comments using the AAC system, and Model is displayed in Figures 3.19 to 3.22. The data displayed in these graphs represent the frequency of caregiver strategy use during the baseline and intervention sessions of the study. The caregiver-child dyad abandoned the study during the intervention phase of the investigation. For this reason, no follow-up data is provided. Data were coded for 3 minutes of each session. To initiate intervention in the first routine, the researcher considered the stable baseline trends detected in the use of Mands/Comment with AAC (Figure 3.21) and Environmental Arrangement (Figure 3.19). When Jason’s caregiver use of both of these strategies were above baseline levels in a stable or ascending trends, the intervention began in the target caregiving routine (snack). Intervention in the target play
routines terminated when caregiver use of Environmental Arrangement and Mands/Comment with the AAC were above baseline levels in three consecutive sessions. As a result of the dyad’s abandonment of the study, the intervention phase of the target caregiving routine was not concluded.

Figure 3.19. Frequency of Jason’s Caregiver Use of Environmental Arrangement across Routines
Figure 3.20. Jason’s caregiver Use of Mands across Routines

Figure 3.21. Jason’s Caregiver Use of Mands/Comments using the Augmentative System
Intervention effects were demonstrated by increase in caregiver use of Environmental Arrangement (EA) for puzzle, coloring, and snack routines following caregiver teaching. During these target routines, the caregiver would typically provide Jason with insufficient amounts of a food item or place the puzzle pieces or crayons within his sight but out of reach (EA). Additionally, increases in the use of Mands/Comment using the AAC (MAAC) were detected during puzzle and coloring subsequent to caregiver teaching. In these play routines, after Jason had requested a puzzle piece or crayon using the AAC system, the caregiver would show him the picture of the item he requested and verbalize its name (MAAC).

Interestingly, Jason’s mother presented initial gains in the use of Mands/Comment using the AAC in the target caregiving routine (snack) following intervention in the target play routines. Likewise, data revealed that she also increased the frequency of Model in one snack episode immediately following intervention in the target play routines. The use of these two strategies, however, presented a downward trend throughout the rest of the study. Following caregiver teaching, Jason’s mother also decreased the use of Mands across all target routines.
In the generalization probes (hand washing and balloon routines), the caregiver presented no consistent changes in the use of Environmental Arrangement, Mands/Comment with AAC, and Model following treatment in the target routines. During these two activities, the caregiver mostly asked Jason questions or manded specific responses. A decreasing trend was, nonetheless, observed for the use of Mands in both untrained routines following intervention in the target routines. Considering that the caregiver-child dyad abandoned the study prior to its conclusion, follow-up data was not collected.

2. The effects of caregiver strategy use on child response type and mode

The frequency of Jason’s Communicative Turn-Taking behaviors (initiations and responses) and Imitative Response is displayed in Figures 3.23 and 3.24. The frequency of Jason’s responses using the AAC system, verbalizations/vocalizations, and gestures/manual signs, are displayed in Figures 3.25 to 3.27. The data displayed in these graphs represent the frequency of child responses during the baseline, intervention, and follow-up sessions of the study. Data were collected for 3 minutes of each session.

![Jason: Communication Turn](image)

*Figure 3.23 Jason’s Communication Turns across Routines*
Figure 3.24 Jason’s Imitative Responses across Routines

Figure 3.25 Jason’s AAC Use across Routines
Figure 3.26 Jason’s Vocalizations and Verbalizations across Routines

Figure 3.27. Jason’s Use of Gestures and Manual Signs across Routines
Overall, the rate of Jason’s communication turns increased across both trained and untrained routines subsequent to caregiver intervention. Interestingly, an ascending trend in child communication turns was detected during the snack routine following intervention in the puzzle activity (target play routine). This trend was maintained throughout the intervention phase of the study. No changes were detected in his use of imitative responses following caregiver treatment. Follow-up sessions were not conducted since the caregiver-child dyad abandoned the study prior to its termination.

In terms of communication modes, Jason increased his use of the AAC system across the puzzle and the snack activities (target routines) during the intervention phase of the study. In these activities, he typically handed the communication symbols (AAC response) to his mother to request food items of specific puzzle pieces. After completing the puzzle he usually pointed to each puzzle piece and vocalized, prompting the caregiver to verbalize the name of each item. As a reflection of this, an increase in the use of gestures and verbal/vocal responses during puzzle (target play routine) was detected. Increases in the use of gestures were also observed during the intervention phase of the balloon and hand washing interactions (untrained routines).

Kevin

1. The effects of the teaching package on caregiver response

The frequency of Kevin’s caregiver use of Environmental Arrangement, Mands, Mands/Comments using the AAC system, and Model is displayed in Figures 3.28 to 3.31. The data displayed in these graphs represent the frequency of caregiver strategy use during the baseline, intervention, and follow-up sessions of the study. Data collection occurred during 3 minutes of each session. The decision to initiate intervention in the first routine was based on the stable trends detected in the caregiver’s use of Environmental Arrangement (Figure 3.28) and Model (Figure 3.31) When Kevin’s caregiver use of both of these strategies was above baseline levels in stable or ascending trends, the intervention began in the target caregiving routine (dinner). The intervention terminated when ascending or stable trends were detected for the use of Mands/Comments using the AAC and Environmental Arrangement in the target caregiving routine. Due to the child participant’s lack of interest in engaging in the computer activity, criteria for the completion of the intervention phase could not be met. In other words, stable or ascending trends above baseline levels in two of the four teaching strategies were not attained in the intervention phase.
Kevin: Caregiver Use of Environmental Arrangement

Figure 3.28. Frequency of Kevin’s Caregiver Use of Environmental Arrangement

Kevin: Caregiver Use of Mands

Figure 3.29. Kevin’s Caregiver Use of Mands across Routines
Figure 3.30. Kevin’s Caregiver Use of Mands/Comments using the Augmentative System

Kevin: Caregiver Use of Models

Figure 3.31. Kevin’s Caregiver Use of Models
Intervention effects were observed by increases in caregiver strategy use above baseline levels for Environmental Arrangement (EA) and Mands/Comment using the AAC (MAAC) for target play (computer) and target caregiving (dinner) routines following caregiver training. Additionally, Kevin’s caregiver continued using these 2 strategies above baseline levels in at least one target routine one month following the termination of the treatment. During the baseline phase of the computer routine, the caregiver requested additional symbols to be incorporated in the AAC system. This specifically happened during the 5th baseline session, which coincided with an increase of caregiver use of Mands/Comment using the AAC in the subsequent sessions. The caregiver typically augmented her speech by pointing to the symbols in the computer communication book (MAAC) or sabotaged the interaction by “accidentally” turning the computer off or selecting the wrong game (EA). During the dinner routine, she would typically use the symbols available in the placemat to augment her speech while asking questions or making comments (MAAC). In terms of Environmental Arrangement strategies, Kevin’s mother would provide him with small amounts of food or place utensils within his sight, but out of reach. No consistent changes were observed for the use of Mands or Model in both target routines during the intervention and follow-up phases of the study.

The use of Environmental Arrangement above baseline levels was observed in only one session of the TV routine (untrained play routine) subsequent to intervention in the target play routine. No change in caregiver rate of Environmental Arrangement was detected in the dressing routine (untrained caregiving routine) following intervention in the dinner routine (target caregiving routine). Likewise, the use of Mands/Comment using the AAC and Model in the untrained routines following caregiver treatment in the target routines remained relatively stable. Contrastingly, Kevin’s mother presented some gains in the use of Mands in both untrained routines following intervention in the target activities. Due to the child participant’s lack of interest in engaging in the TV routine, only one follow-up session could be conducted. In this context, no trend in strategy use could be determined for the untrained play routine.

2. The effects of caregiver strategy use on child response type and mode

The frequency of Kevin’s Communicative Turn-Taking behaviors (initiations and responses) and Imitative Response is displayed in Figures 3.32 and 3.33. The frequency of Kevin’s responses using the AAC system, verbalizations/vocalizations, and gestures/manual signs, are displayed in Figures 3.34 to 3.36. The data displayed in these graphs represent the
frequency of child responses during the baseline, intervention, and follow-up sessions of the study. Each session had a duration of 3 minutes.

**Figure 3.32.** Kevin’s Communication Turns across Routines
Figure 3.33 Kevin’s Imitative Responses across Routines

Figure 3.34 Kevin’s AAC Use across Routines
Kevin: Verbalizations and Vocalizations

Figure 3.35 Kevin’s Vocalizations and Verbalizations across Routines

Kevin: Gestures and Manual Signs

Figure 3.36. Kevin’s Use of Gestures and Manual Signs across Routines
Overall, Kevin presented gains in his rate of communication turns following caregiver intervention in the computer, TV, and dinner routines. Despite the initial gains in the target play routine (computer), Kevin presented a dramatic decrease in the frequency of turns taken in the last two computer sessions. In both of these episodes, he had difficulty in staying focused in the activity, which he gradually lost interest in the subsequent sessions.

Following caregiver treatment, Kevin decreased his rate of imitative responses in the computer, TV, and dressing routines across the treatment and follow-up phases of the investigation. He presented some instances of imitative responses during the dinner routine following intervention. These were typically echolalic responses to his mother’s verbal prompts. No clear trend in the use of this response type was, however, established.

In terms of child communication modes, Kevin presented gains in the use of the AAC system, verbalizations/vocalizations, and gestures/manual responses in at least one trained or untrained routine following caregiver intervention. Precisely, post intervention data indicated that he enhanced the use of the AAC system during computer and dinner routines. These gains, however, were not maintained one month following the termination of the treatment. Likewise, data revealed that no systematic changes in Kevin’s use of the AAC system across the dressing and TV activities (untrained routines) were observed following caregiver intervention.

An increase in the use of verbal/vocal responses were detected in the initial computer sessions following caregiver training. By the 4th computer session, the frequency of verbal/vocal responses decreased to baseline levels. This coincided with Kevin’s gradual lack of participation and interest in this activity. Interestingly, Kevin increased his rate of verbal/vocal responses during dinner subsequent to caregiver training in computer routine. No systematic changes in this response mode were observed in the other routines.

During the computer and TV sessions, Kevin exhibited a relatively low and stable use of gestures throughout the 3 phases of the study. In the last follow-up computer session, however, his rate of gestures/manual signs increased dramatically. In these episodes, he combined the use of verbalizations and manual signs to initiate or respond to his mother.
Summary

1. Caregiver strategy use

The effectiveness of caregiver training on each teaching strategy was analyzed using the Percentage of Nonoverlapping Data method (Scruggs et al., 1987). Tables 3.1 and 3.2 indicate the PND scores for each caregiver strategy use in the target routines and generalization probes.

Table 3.1
*Percentage of Nonoverlapping Data for Caregiver Strategies in the Target Routines*

<table>
<thead>
<tr>
<th></th>
<th>EA</th>
<th>Mand</th>
<th>MAAC</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caregiver</td>
<td>P</td>
<td>C</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>Barney’s</td>
<td>100</td>
<td>16</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Charlie’s</td>
<td>73</td>
<td>72</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Jason’s</td>
<td>88</td>
<td>60</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>Kevin’s</td>
<td>56</td>
<td>67</td>
<td>11</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: P = target play; C = target caregiving; EA = Environmental Arrangement; MAAC = Mand/Comment using the AAC.

Table 3.2
*Percentage of Nonoverlapping Data for Caregiver Strategies in the Generalization Probes*

<table>
<thead>
<tr>
<th></th>
<th>EA</th>
<th>Mand</th>
<th>MAAC</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caregiver</td>
<td>P</td>
<td>C</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>Barney’s</td>
<td>60</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Charlie’s</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Jason’s</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Kevin’s</td>
<td>30</td>
<td>30</td>
<td>60</td>
<td>80</td>
</tr>
</tbody>
</table>

Note: P = generalization play routines; C = generalization caregiving routines;
PND scores of 90 or above indicate an effective treatment; scores between 70 and 89 suggest treatments that are moderately effective; scores between 50 and 69 indicate mildly effective interventions and 49 or below imply ineffective treatments. In the current investigation, caregiver training for Environmental Arrangement strategy was either moderately or mildly effective for all caregivers in both target routines, with one exception. Only 16% of postintervention data points were above baseline levels for Barney’s mother during the target caregiving routine, characterizing it as an ineffective treatment. In the generalization probes, the treatment was considered mildly to highly effective for Barney and Charlie’s mother in the play probes, but not during caregiving sessions. No significant changes were observed for Jason and Kevin’s mothers in either generalization probe routines.

All caregivers successfully used Mands prior to intervention in all trained and untrained routines. No significant changes were detected in strategy use for all caregiver participants during both target routines. In the generalization probes, however the use of Mand significantly increased for Charlie’s mother during the puzzle routine and Kevin’s caregiver during both untrained routines.

Caregiver training for the use of Mand/Comment using the AAC was considered from mildly to moderately effective in, at least, one target routine for the four caregivers. On the other hand, only Barney’s mother had post intervention data points significantly above baseline levels in the generalization play probes. The remaining caregivers did not show significant increase in the use of this strategy following treatment in the target routines.

The use of Model was limited for all caregivers in all phases of the study. In the target routines, caregiver training on strategy use was only considered mildly effective for Barney’s caregiver. Likewise, in the generalization sessions, the treatment procedures only produced significant changes in Charlie’s mother’s use of Model during the puzzle routine.

In summary, the intervention was considered effective for Barney and Charlie’s mothers’ use of Environmental Arrangement, Mand/Comment with AAC and Model in at least one target routine subsequent to treatment. Theses same caregivers were also able to effectively generalize the use of two of these strategies to, at least, one untrained routine. Kevin’s caregiver presented significant intervention gains in the use of Environmental Arrangement and Mand/Comment with AAC in, at least, one target and one generalization routine. Kevin and Charlie’s mothers additionally presented PND scores above 50 for the use of Mand in at least one untrained
routine. The intervention was also considered effective for Jason’s mother’s use of Environmental Arrangement across both target routines and the use of Mand/Comment with AAC in the target play routine. Follow-up measures indicated that the three caregivers that concluded the study continued using at least two of the intervention techniques above baseline levels one month following the termination of the study.

2. The effects of caregiver strategy use on child response type and response mode

Two types of child communicative behaviors were coded in this investigation: turn taking responses and imitative responses. The first type of response (turn taking) referred to the child’s initiations or responses to the caregiver’s interaction. The second (imitative response) referred to the child’s imitation of the caregiver’s verbal/vocal, manual/gestural, or AAC prompts.

The modality of each child communication turn and imitative responses were additionally analyzed in this study. These behaviors were categorized as: a. child response using the augmentative communication system (AAC); b. child response using verbalizations/vocalizations; and c. child response using gestures/manual signs. Each type of response (communication turn or imitative response) could be coded as one or more modalities. In other words, if the child participant indicated to the caregiver that he wanted a toy by pointing to it and verbalizing its name, this response would be coded as a communication turn with two modalities: verbal/vocal and gesture/manual signs.

The effectiveness of caregiver use of the naturalistic teaching strategies was analyzed using the Percentage of Nonoverlapping Data method (Scruggs et al., 1987). Table 3.3 and 3.4 indicate the PND scores for each child behavior in the target routines and generalization probes.
Table 3.3
Percentage of Nonoverlapping Data for Child Behavior in the Target Routines

<table>
<thead>
<tr>
<th>Turn</th>
<th>Imitative rsp</th>
<th>AAC use</th>
<th>Gest/MS</th>
<th>Verb/Voc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P</td>
<td>C</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>Barney</td>
<td>67</td>
<td>20</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Charlie</td>
<td>82</td>
<td>73</td>
<td>33</td>
<td>0</td>
</tr>
<tr>
<td>Jason</td>
<td>100</td>
<td>20</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Kevin</td>
<td>11</td>
<td>0</td>
<td>12</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: P = target play routines; C = target caregiving routines; rsp = response; Gest/MS = gestures and manual signs; Verb/voc = verbalizations and vocalizations; PND scores: 90 or above = effective treatment; 70-89 = moderately effective treatment; 50-70 = mildly effective treatment; 49 or below = ineffective treatment

Table 3.4
Percentage of Nonoverlapping Data for Child Behavior in the Generalization Probes

<table>
<thead>
<tr>
<th>Turn</th>
<th>Imitative rsp</th>
<th>AAC use</th>
<th>Gest/MS</th>
<th>Verb/Voc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P</td>
<td>C</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>Barney</td>
<td>40</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Charlie</td>
<td>100</td>
<td>50</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Jason</td>
<td>100</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Kevin</td>
<td>67</td>
<td>33</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: P = target play routines; C = target caregiving routines; rsp = response; Gest/MS = gestures and manual signs; Verb/voc = verbalizations and vocalizations; PND scores: 90 or above = effective treatment; 70-89 = moderately effective treatment; 50-70 = mildly effective treatment; 49 or below = ineffective treatment
Caregiver use of the naturalistic teaching strategies was from mildly to highly effective at enhancing Barney, Charlie, and Jason’s communicative turn taking behaviors in, at least, one target routine. Additionally, Charlie and Jason significantly increased their rates of initiations and responses in both generalization activities. This same pattern was observed for Kevin during the generalization play probes. No significant changes were detected in the use of imitative responses for all child participants across both target and caregiving routines.

For the use of the AAC system, the treatment effects were significant for all child participants in the target play routines. Caregiver strategies were from moderately or highly effective at enhancing Charlie’s AAC use during the target caregiving routine and one generalization activity. No changes were detected for the other participants in the remaining routines.

The effects of the intervention on Barney, Charlie and Jason’s verbal and/or vocal behaviors were from mildly to moderately effective in at least one routine. Likewise, the treatment significantly increased Jason’s use of gestures/manual signs in one target routine and in both generalization activities.

In summary, the naturalistic teaching strategies used by the caregivers were effective at enhancing the frequency of communicative turn-taking behaviors and the use of the augmentative communication system for all child participants in, at least, one routine. The treatment was also considered effective for increasing Barney, Charlie and Jason’s verbal/vocal behaviors in, at least, one routine. PND scores above 50 were also detected for Jason’s use of gestures/manual signs across three routines. None of the participants presented significant PND scores for the use of imitative responses.

3. Caregiver-child interaction

PND scores revealed that caregiver use of Environmental Arrangement and Mands/Comments Using the AAC System were superior to baseline data in, at least, one target routine for the four caregivers. Likewise, postintervention data for child Turn and AAC Uses were superior to baseline conditions in at least one target routine for the four child participants, with one exception. Only Kevin’s AAC Use was significantly different. In this context it was pertinent to analyze the effects of caregiver use of Environmental Arrangement and Mands/Comments using the AAC System on child Turn and AAC responses for Barney, Charlie
and Jason. Additionally, the effects of caregiver strategies were also analyzed for Kevin’s AAC use.

1. Child Communication turns, AAC use, Caregiver use of Environmental Arrangement, and Mands/Comments using the AAC

Child Communication Turns, AAC Use, and caregiver use of Environmental Arrangement and Mands/Comment using the AAC System is displayed in Figures 3.37 to 3.39.

Figure 3.37. Barney: Child Communication Turn, AAC Use and Caregiver Environmental Arrangement and Mands/Comments w/ AAC
Charlie: Child Communication Turn, AAC Use, Caregiver Use of Environmental Arrangement and Mand/Comment using the AAC

Jason: Child Communication Turn, AAC Use, Caregiver Use of Environmental Arrangement and Mand/Comment using the AAC

**Figure 3.38.** Charlie: Child Communication Turn, AAC Use, Caregiver Use of Environmental Arrangement and Mand/Comment using the AAC

**Figure 3.39.** Jason: Child Communication Turn, AAC Use, Caregiver Use of Environmental Arrangement and Mand/Comment using the AAC
During the baseline phase of the target routines Barney, Charlie, and Jason’s caregivers used, in some instances, one or both of the strategies with relatively low frequencies. In these episodes, the frequency in which Barney, Charlie and Jason initiated or responded or used the augmentative communication device was also low. Following intervention, the rate of caregiver strategy use gradually increased. Likewise, despite variability among sessions, an increase in the frequency of child turn taking and AAC use were also observed for these three participants.

Figure 3.40 displays Kevin’s AAC use and Kevin’s caregiver use of Environmental Arrangement and Mands/Comments using the AAC device. Data from this figure indicates a significant postintervention increase in caregiver use of Mandss/Comments using the augmentative device during caregiving routine. A clear ascending trend is also observed for caregiver use of Environmental Arrangement for both target routines following treatment. As Kevin’s caregiver increased the use of both strategies in the intervention phase of the study, an enhancement in Kevin’s use of the augmentative communication system was also observed.
Social Validity

Social validity data measures provided data related to two issues: 1) caregiver perception of the intervention package and 2) caregiver perceptions of child communication gains. Each are discussed below.

Caregiver Perception of the Intervention Package

At the end of the follow-up phase, Barney, Charlie and Kevin’s mothers completed 3 questionnaires to evaluate: (1) the teaching program; (2) their perception on their child’s communication gains; and (3) opportunities provided for child AAC use. Table 3.5 displays caregiver evaluation of the training program.

Table 3.5

Teaching Program Evaluation

<table>
<thead>
<tr>
<th>Questions</th>
<th>Barney’s</th>
<th>Charlie’s</th>
<th>Kevin’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How easy is it to learn to use the naturalistic teaching strategies?</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2. How easy is it to use the AAC system when implementing the naturalistic teaching strategies?</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3. How easy is it to incorporate the naturalistic strategies within your routines?</td>
<td>2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>4. How much do you think this treatment helped your child use the AAC system?</td>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5. How much do you think this treatment helped your child become a more successful communicator?</td>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: M = Mean; 1 = not easy/ not much help; 2 = somewhat easy/ somewhat helped; 3 = mildly easy/ mildly helped; 4 = moderately easy/ moderately helped; 5 = very easy/ helped very much
Overall, the caregivers considered the naturalistic teaching strategies relatively easy to learn and implement. Charlie and Kevin’s mother also reported that the strategies were in general easy to incorporate in the routines; that these procedures helped their sons to use the AAC system; and that the treatment helped the children become more successful communicators. Barney’s mother stated that the strategies were somewhat easy to incorporate and that the procedures moderately helped Barney use the system and become a successful communicator.

**Caregiver Perception of Child Communication Gains**

Caregiver perception of child communication gains is displayed in Table 3.6. Charlie and Kevin’s mothers strongly agreed that, as a result of using the AAC system, their communication was better with their sons and that the children had less communication breakdowns. Barney’s mother, on the other hand, had a neutral opinion in both questions. All three caregivers disagreed that the AAC restricted communication, carried a stigma, or was a burden. The three caregivers were positive about their children using the AAC device. Likewise, they strongly agreed that their sons were able to convey positive and negative emotions using the system, as well as express needs and wants. Charlie and Kevin’s mothers thought the system helped their sons express physical well-being, while Barney’s mother had a neutral opinion.

Table 3.6

**Caregiver Perception of Child Communication Gains**

<table>
<thead>
<tr>
<th>As a result of using AAC:</th>
<th>caregivers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Barney’s</td>
</tr>
<tr>
<td>My communication with my child is better.</td>
<td>N</td>
</tr>
<tr>
<td>I feel the AAC restricts communication</td>
<td>D</td>
</tr>
<tr>
<td>My child has fewer communication breakdowns</td>
<td>N</td>
</tr>
<tr>
<td>I feel the AAC device carries a stigma</td>
<td>D</td>
</tr>
<tr>
<td>I feel the device is a burden</td>
<td>D</td>
</tr>
</tbody>
</table>
Table 3.6. Continued

<table>
<thead>
<tr>
<th>As a result of using AAC:</th>
<th>Caregivers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Barney’s</td>
</tr>
<tr>
<td>I am positive about my child using the AAC</td>
<td>SA</td>
</tr>
<tr>
<td>My child can convey positive emotions</td>
<td>SA</td>
</tr>
<tr>
<td>My child can convey negative emotions</td>
<td>SA</td>
</tr>
<tr>
<td>My child can express physical well-being</td>
<td>N</td>
</tr>
<tr>
<td>My child can express needs and wants</td>
<td>SA</td>
</tr>
</tbody>
</table>

Note: SD – strongly disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly agree

Treatment Fidelity

To verify that the researcher was implementing the intervention as described in the caregiver training protocol, the research assistants completed treatment fidelity checklists for every caregiver teaching session (phase 3) and 30% of the caregiver intervention sessions (phase 4). In total, the assistants completed 8 treatment fidelity checklists during the caregiver teaching sessions and 54 treatment fidelity checklists during the caregiver intervention sessions. Results from this assessment showed that the researcher followed the steps in the training and intervention protocols with 100% accuracy.

Reliability

To measure reliability, the researcher independently coded 30% of the sessions (including baseline, intervention and follow-up phases) coded by the assistants throughout the study. To correct for chance agreement, Kappa scores were calculated as a second measure of reliability.

In average, agreement between caregiver strategy was 83%; agreement between child communication turn and imitative response was 82%, and child communication mode was 83%. The Kappa score for caregiver strategy use was 0.74. Child communication turn and imitative response was 0.78 and child communication mode was 0.79.
The purpose of this study was to evaluate the effects of a parent-implemented naturalistic intervention on the communication outcomes of four children with autism using augmentative communication devices. The researcher was initially interested in knowing if the intervention program was effective in teaching the four caregivers to implement four naturalistic teaching strategies using visual-graphic systems of communication during home routines. The second question referred to the effects of caregiver strategy implementation on the children’s communication outcomes, specifically focusing on the children’s communication turn-taking skills, imitative behaviors and the use of different modes of communication (verbal/vocal, using the AAC system and using gestures/manual signs). Additionally, the author was interested in how the parents involved in the teaching program evaluated the intervention and if they perceived changes in their children’s communication repertoire following the intervention program.

A multiple baseline design across routines with replication across caregiver-child dyads indicated that the caregivers learned to implement the naturalistic teaching procedures using the visual-graphic systems of communication in the home routines. As an effect of caregiver implementation of the teaching procedures, the four child participants enhanced their frequencies of communicative turn-taking behaviors and use of the augmentative communication system in at least one home routine. Three of these children additionally increased their frequency of verbal/vocal responses, while one child began using more gestures/manual signs subsequent to intervention. Changes in the rate of imitative responses were not significant for any of the four child participants, considering the PND scores analyzed.
The three caregivers that completed the study had positive perceptions of the use of augmentative communication devices, did not find difficulty in learning the teaching procedures, and agreed that the intervention helped their children become better communicators.

The results from this investigation support findings from previous studies. Data revealed that caregivers were able to combine the use of naturalistic teaching strategies with the use of AAC systems in the natural environment (Cafiero, 2001; Hamilton & Snell, 1993; Kaiser et al., 1993; Stiebel, 1999). Consistent with other AAC studies involving participants with ASD (Bondy & Frost, 1994; Cafiero, 2001; Hamilton & Snell, 1993; Kravit et al., 2002; Schwartz et al., 1998; Stiebel, 1999; von Tetzchner et al., 2004) the children with ASD in this investigation successfully learned to communicate using visual-graphic systems of communication. The use of other communication modes, such as verbalization and gestures, were also enhanced with the introduction of the AAC device. Similar results were found in studies involving participants with ASD using picture based systems (Bondy & Frost, 1994; Cafiero, 2001; Charlopt-Christy et al., 2002; Ganz & Simpson, 2004; Kravits, 2002; Schwartz et al., 1998). The caregivers involved in the current investigation had a positive attitude toward AAC, did not feel the system as a burden, and felt that their children could better express themselves using the pictures. Similar findings were reported in investigation conducted by Angelo (2000).

Results from this study add to the literature supporting parent implemented AAC intervention for children with ASD. These findings extend previous AAC studies based on the 1) intervention milieu and participant characteristics and 2) the types of intervention strategies and outcome measures used.

**Milieu and Participant Characteristics.** From the 46 AAC studies analyzed, only 7 had the individuals’ homes as one of the intervention settings (Cummings & Williams, 2004; Hamilton & Snell, 1993; Kravits et al., 2002; Light et al., 1998; MacDuff et al., 1993; Stiebel, 1999; Vaughn & Horner, 1995). From these studies, only four investigations (Hamilton & Snell, 1993; Kravits et al., 2002; Light et al., 1998; Stiebel, 1999) included caregivers as intervention agents. Psychosocial and educational levels of the caregiver participants involved were not cited in any of the studies. Additionally, only one investigation reported the child participant’s psychosocial profile. Ethnicity and racial descriptions were provided for only one caregiver and 5 children in the 46 studies analyzed. This is a critical issue, considering the diverse needs, priorities and concerns of populations from different backgrounds. African-American, European-
American and Asian American families have, for instance, been reported to have distinct perceptions regarding the use of AAC systems (Parette & Huer, 2002; Parette et al., 2002).

Many of the AAC studies analyzed failed to provide appropriate measures of the child participants’ cognitive, motor, sensory, language and communication abilities. The current investigation provides evidence that caregivers of children with ASD, with various SES and educational levels can effectively learn to implement AAC interventions with their children in the home environment. This study also suggests that children with ASD with various levels of cognitive, language, motor, and communication abilities can successfully learn to use picture communication systems in the natural milieu.

**Intervention Strategies and Outcome Measures.** Only two of the AAC studies analyzed (Hamilton & Snell, 1993; Stiebel, 1999) clearly included caregiver AAC use as an intervention strategy. In both of these investigations parents were instructed to ask questions using the AAC device or model responses using the system. In the current study, parents were encouraged to use the system not only to make requests and model responses, but also make comments. The idea of having caregivers use Mands/Comments using the AAC system was to augment speech in various communicative contexts, rather than just asking questions or prompting the use of the device. As discussed in the research literature, children with autism often have difficulties in comprehending verbal language (Mirenda & Santogrossi, 1985; von Tetzchner et al., 2004) and the use of a visual mode of communication by a social partner has been reported to clarify speech in AAC users (Romski & Sevcik, 1993).

From the 46 AAC studies analyzed, only Hamilton and Snell (1993) specified the effects of each intervention strategy on participant communicative responses. The remaining studies examined the effects of intervention “packages” on child outcomes. In addition to child AAC use, Hamilton and Snell (1993) measured, under the general rubric of “other communicative responses”, the participants’ use of gestures and vocalizations. The current investigation adds to the literature by analyzing the effects of each caregiver implemented intervention strategy on individual frequencies of child use of gestures/manual signs and verbalizations/vocalizations.

Eleven of the forty-six studies analyzed reported social validity measures. Six of these investigations included parent satisfaction questionnaires or anecdotal measures of caregiver evaluation of the intervention (Bernard et al., 1999; Hamilton & Snell, 1993; Light et al., 1998; Magiati & Howlin, 2000; Stiebel, 1999; Tincani, 2004). Only one of these studies (Stiebel, 1999)
specifically evaluated parent opportunities for child AAC use in nonexperimental contexts. In that study, Stiebel (1999), using pre-post measures, indicated that all parent participants encouraged AAC use with greater frequency following the intervention. Opportunities to use the system in the community and with other social partners were not specified. The current study adds to the literature by providing measures of caregiver opportunities for child AAC use in alternative settings. Data indicated that only one of the three parents that completed the study took the system to the community and provided opportunities for the child to use the system with other social partners. The limited use of AAC systems outside instructional settings and involving unfamiliar partners has been previously discussed in the research literature involving participants with other types of disabilities (Blackstone, 1999; Blackstone & Hunt Berg, 2003; Light et al., 1985; Udwin & Yule, 1990).

**Effects of the Teaching Program on Caregiver Behavior**

**Caregiver Behavior: Strategy Prioritization**

In the current investigation, postintervention changes were more prominent for caregiver use of Environmental Arrangement, Mands/Comments using the AAC system, and the use of Mands. The four caregiver participants showed increase in the use of the first two strategies following treatment, while only one presented stable gains in the use of Model. Three of these caregivers decreased the use of Mands in the target routines subsequent to caregiver training.

The expanded use of Mands/Comments using the AAC and Environmental Arrangement strategies was concurrent to a decrease in the use of Mands for Barney, Charlie and Jason’s caregivers during the target routines. Kevin’s mother, on the other hand, maintained an interchanging pattern between high frequencies of Mands, low frequencies of Mands/Comments with the AAC, and vice-versa throughout the study. Similar trends were observed in the generalization probes of two caregiver participants. Barney’s mother maintained a descending trend in the use of Mands and ascending trends in the use of Mands/Comments using the AAC and Environmental Arrangement strategies in the untrained routines. Kevin’s caregiver continued interchanging high uses of Mands with low Mands/Comment using the AAC. Other patterns of caregiver strategy use were observed in Charlie and Jason’s generalization routines. Charlie’s mother maintained high rates of Mands and Environmental Arrangement, while using very limited frequencies of Mands/Comments using the AAC following intervention. Jason’s
caregiver significantly decreased the use of Mands in both untrained routines and maintained a stable trend in the use of the other two strategies.

The prioritization in caregiver use of specific teaching strategies in intervention programs where multiple teaching techniques are used has been previously reported in the research literature (Elder, 1995; Girolametto, 1988; Kaiser et al., 1993; Kaiser et al., 2000; Kashinath, 2002; Nunes, Hanline & Kashinath, 2005). These studies have shown that caregivers, when taught multiple teaching strategies, have prioritized the use of one learned strategy over another. In a pilot study conducted by Nunes et al., (2005), where the same teaching procedures used in the current study were applied, postintervention data revealed that the parent of a child with autism concurrently enhanced the use of Environmental Arrangement and Mands/Comments using the AAC while decreasing the use of Mands. In research studies where other teaching strategies were investigated, this same phenomenon was observed. Kaiser and colleagues (2000), for example, reported that one of the parents in their investigation presented small changes in the use of milieu teaching strategies and moderately strong changes in other teaching procedures following intervention. Similarly, Kashinath (2002) reported that 2 caregivers in her study temporally decreased the use of one teaching strategy when a second teaching technique was introduced. Likewise, in a parent-implemented intervention study conducted by Elder (1995) one of the caregivers temporarily discontinued the use of an imitation strategy with her child once the interventionist taught the use of a “waiting” procedure. Elder (1995) attributed this interruption to the caregiver’s comfort level. In other words, the caregiver thought it was difficult to implement more than one strategy at a time and only continued the use of imitation once she felt comfortable in using the second learned strategy.

In the current study, the substitution of Mands for Mands/Comments using the AAC for some of the caregiver participants may have a similar rationale. Prior to the onset of the intervention, the caregivers already displayed high frequencies of Mands and used the AAC system less frequently to ask questions or make comments. Hypothetically, as they felt more comfortable in using the communication device in these instances, they gradually reduced the use of Mands. Considering that the purpose of Mands and Mands/Comments using the communication device were, at times, functionally equivalent (both serving to elicit child response), it is plausible to think that the caregivers “substituted” simple verbal Mands with Mands/Comments using the aided device.
The increase in use of less intrusive strategies, such as Environmental Arrangement, seemed to provide the child participants with more opportunities to initiate communication turns, specially using the aided device. This finding is consistent with previous AAC studies involving participants with ASD, where the use of this intervention procedure has been associated with greater frequencies of child communication turns using aided or unaided systems of communication (Kouri, 1988; Kravits et al., 2002; Schepis et al., 1982; Schepis et al., 1998). In these studies, the use of Environmental Arrangement, combined with other naturalistic strategies was also associated with increase in verbalizations (Kouri, 1988; Schepis et al., 1998) and nonverbal communication behaviors, such as gestures (Kouri, 1988). Similar findings were also reported in this study, where the caregivers’ use of Environmental Arrangement was associated with the children’s increased verbalization/vocalizations and one participant’s use of gestures.

**Caregiver Behavior: Using the Strategies and Incorporating the System**

The four caregiver participants were, overall, successful at incorporating the picture symbols to ask questions or make comments (Mand/Comment using the AAC) during the intervention. When needed, they also appropriately prompted their children to use the pictures for protoimperative functions, such as requesting more food or play items (Model). Notwithstanding the importance of this behavior, the researcher observed that modeling the use of the system for protodeclarative functions seemed, at times, limited. In other words, despite symbols such as “I like that”, “I don’t like”, and “all done” being available on the placemats, the mothers infrequently prompted their children to use them to make comments during the interactions. As a consequence, following the intervention sessions, the parents had to be reminded that the AAC system could also be used for their children to express that they enjoyed an activity, disliked the taste of a certain food, or wanted to terminate an interaction.

Following each caregiver intervention session, the researcher asked the mothers if they needed additional AAC symbols to be used in the routines or in any other activities. In some instances, the caregiver provided the researcher with the symbol she wanted. This could be, for instance, a paper label taken from a cracker box the child would use in the snack routine. If the caregiver did not have the requested symbol, the researcher used a digital camera to take pictures of the items or utilized ready made PCS symbols to fabricate the AAC picture. The researcher was responsible for laminating and attaching Velcro to the pictures prior to their use.
Depending on the child’s needs, pictures of new food items, other types of puzzle pieces, playdough shapes, or new computer activities were gradually added to the set of symbols used in the target and generalization routines. Additionally, the caregivers would also request symbols to clarify “transitions” and point out sequence of every day events. Kevin’s mother, for instance, requested a symbol of “stop” to indicate that it was time for Kevin to stop watching TV and go to bed. Likewise, Barney’s mother asked for a picture of a “toothbrush”, to indicate to her son that it was time to terminate his play activity and brush his teeth. A symbol of the family’s car and of Barney’s speech therapist were also made available to point out that they would drive to the clinic for Barney to attend a speech session.

Picture symbols to be used out of the home setting were also requested. While participating in the study, Jason’s mother commented that she wanted a picture of the food items present in a certain restaurant in order to facilitate Jason’s meal selection. Since the dyad abandoned the study prior to its termination, the researcher was not able to give the new pictures to the dyad. Similarly, Charlie’s mother requested a picture of a restaurant and of a food market the family typically went to. She mentioned that these pictures, normally used during the car trips, helped explain to Charlie the chain of events he would experience and prevent meltdowns.

In addition to symbols used to point out transitions and sequence of events, a symbol to clarify information available on the AAC system itself was incorporated to Charlie’s communication system. During a home visit, Charlie’s mother commented that her son had difficulties understanding that, despite a symbol being accessible, the food/play items were, at times, not available. In some instances, Charlie had tantrums, such as screaming or biting his hand when his AAC requests were not attended. In this case, the interventionist suggested the use of a “no” symbol. This was a transparent card with a red crossed circle that the mother put in front of the picture symbol to indicate that the item was not available. After some days of trial, the caregiver reported that Charlie was better comprehending the unavailability of certain items, despite their representation on the AAC system.

**Caregiver Behavior: Child Effects**

Within a *transactional analysis* (Halle, 1984; Wetherby & Prizant, 2000), caregiver strategy use can also be attributed to the children’s response patterns. Using this framework, we notice that the child participants responded and initiated more frequently when the caregivers began using the communication device to make questions or comments (Mands/Comments using...
the AAC), instead of using only verbal Mands. Considering that children with autism may have difficulty in comprehending verbal language (Mirenda, 1985; NRC, 2001; Prizant, 1987), it is it is reasonable to assume that the children responded less frequently to simple verbal Mands because they did not comprehend what the caregivers were saying. As the caregivers began to augment their speech with the picture system, the number of communication turns increased - possibly indicating that the child participants began to better comprehend caregiver verbalizations. As the caregivers acknowledged this behavior, they may have intentionally increased their use of the communication device to be better understood by their children. As a result, increases in the use of Mands/Comments using the AAC were observed. This replicates findings from the research literature, where individuals with ASD have been reported to improve verbal language comprehension when communication partners augment speech with visual-graphic modes (Peterson et al., 1995; Schuler, 1995; Vaughn & Horner, 1995; Von Tetzchner et al., 2004). As discussed by Bernard-Opitz and colleagues (1999), visual feedback to sounds might be an avenue for non-verbal children to understand one important basis of communication: that sounds have an effect on the environment.

Three of the four caregivers rarely used Models with their children throughout the intervention. The underuse of this teaching procedure replicates findings from previous AAC studies (Hamilton & Snell, 1993; Nunes et al., 2005), where the primary interventionists rarely used this strategy following the initial instructional sessions. Hamilton and Snell (1993) state that model prompts were “least often required”, suggesting that the child participant quickly learned to use the communication book and did not need further prompting. Similarly, Nunes et al. (2005) suggested the child participant’s father discontinued the use of Models as soon as his son began using the system consistently. Likewise, in the current study, the underuse of Models can be attributed to the children’s rapid learning in how to use the picture communication system appropriately. In other words, since the children began using the pictures to communicate in the initial teaching sessions, there seemed to be no need for the caregivers to model how to use the AAC system in subsequent interactions. As opposed to the other children in this study, Barney showed timid gains in the use of the AAC system. Consequently, his mother continued using high frequencies of Models to teach him how to use the AAC system appropriately.
Caregiver Behavior: Effects of the Routines

In the current study, caregiver strategy use also varied according to the type of play or caregiving routines analyzed. The frequency of caregiver use of Environmental Arrangement, for example, was higher during mealtime (target caregiving routine) than in hand washing (generalization probes) for the three caregiver participants involved in these routines. One possible explanation is that the caregivers failed to generalize this strategy from the trained to the untrained sessions. An alternative explanation, however, could be that the routine in itself provided fewer opportunities for strategy use than the target caregiving routine. Environmental Arrangement involved placing the AAC system within the child’s reach and objects out of reach, placing oneself between the child and the desired materials or activities, sabotaging an activity, and/or providing her with inadequate portions of a desired item. The nature of the hand washing routine made it difficult to place the AAC system close to the child and the items out of reach. Since it was an activity involving water, the caregiver preferred to use a laminated board that was placed above the kitchen sink. The AAC system was, therefore, not readily accessible to the child. Additionally, the sink space was generally small, making it difficult to find areas to place objects within the child’s sight, but out of reach. Likewise, there was limited space for the caregiver to place herself between the routine materials and the child, and a small number of items were used. Contrastingly, the number of opportunities to use Environmental Arrangement during mealtime seemed greater. The caregivers were able to place the AAC system close to the child and, while sitting face-to-face to them, had better control of putting items out of reach. There were more materials used and greater chances of applying certain techniques, such as providing limited amounts of desired items than during hand washing. In other words, it was easier to give the child a small piece of a cookie several times than provide limited amount of soap several times.

Another example of same class routines that elicited different caregiver response patterns was playing on the computer and watching TV. Greater frequencies of caregiver use of Mands/Comments using the AAC, Environmental Arrangements and even Models were observed in Kevin’s computer routine when compared to the TV activity. Overall, the computer games seemed to provide more caregiver-child interaction opportunities than the TV routine. The computer games were brief cartoon interactional musical clips, where the child had to click on specific icons to watch the characters dance/sing on the screen. Since Kevin was unable to
independently manipulate the computer mouse, his mother used the communication book to ask what he wanted to do and what characters he wanted to see. Considering that the mother had control over the computer, she would “accidentally” turn it off (sabotaging strategy - Environmental Arrangement) or even select the wrong clip to elicit child response. The clips were brief, lasting from 15 to 20 seconds, and therefore provided multiple opportunities for Kevin to make choices within the same session. The TV routine, on the other hand, consisted of playing different dvd’s and vhs tapes and making comments. Kevin’s mother used the communication book for Kevin to select the film he wanted to watch and to comment on different scenes. She would also use some Environmental Strategies, such as putting the tapes out of Kevin’s reach, to elicit child response. The duration of the video sequences were, however, significantly greater than the computer clips and, although the caregiver tried to make comments using the communication book, Kevin seemed to be more attuned to watching the television screen than making comments about it.

Functionally similar routines seemed to provide comparable number of opportunities for caregiver strategy use. Barney and Charlie’s mothers, for example, used similar rates of Environmental Arrangement and Mands/Comments using the AAC across target and generalization play routines. The strategies were probably easier to generalize from one activity to the other due to their structural similarities. The play routines had similar physical arrangements, with the child sitting face-to-face to the caregiver at a large table where various items could be placed. Additionally, the materials used in these activities were multi-part play items, such as puzzles, Lego’s, crayons, shapes, and play dough. The nature of the routine in itself facilitated the use of Environmental Arrangement strategies, such as providing the children with insufficient number of puzzle pieces, reduced amount of playdough or Lego’s; standing between the child and the desired items or sabotaging the activity. If the child failed to initiate the interaction, the caregiver typically prompted her by using the AAC system (Mands/Comments using the AAC).

**Effects of the Teaching Program on Child Outcomes**

**Child Outcomes: Communication Turns**

Studies have found that the characteristics of a task may directly affect the levels of child responsiveness (Kashinath, 2002; Keen et al., 2001; O’Neill & Swetland-Baker, 2001). In the
current investigation, all child participants seemed to make more initiations and respond more consistently during the play interactions when compared to the caregiving activities. As previously discussed, the nature of the routines possibly affected the provision of caregiver communication opportunities. An alternative explanation could be that the child was more motivated to engage in some interactions than others. Overall, they appeared to be more responsive while playing with puzzles, play dough, or the computer, than while washing hands or dressing, for instance. The interest in these activities also varied across time. Kevin, for instance, seemed extremely motivated to play on the computer in the initial sessions. Following, approximately, two months of treatment, he appeared no longer interested. When he did engage in the computer activity, this would be for a limited amount of time. As a consequence, his level of responsiveness decreased and the number of computer sessions in the study was shortened.

**Alternative reinforcers.** The events succeeding the experimental sessions may also have influenced child levels of responsiveness. During the caregiving routines, for instance, Barney’s mother would typically give him small portions of food at a time. When the session resumed - and if Barney had not eaten everything - his mother would occasionally call him back to the table and give him the rest of the snack without his request. These events may have ultimately reinforced Barney to wait for his caregiver to feed him rather than request food. Similar behavior patterns took place during some play sessions, specifically during Lego’s. In these episodes, the mother would give him 2 or three Lego pieces at a time. When he showed disinterest in playing, the session terminated. As soon as the mother put the Lego’s away, he would indicate through vocalizations or gestures that he wanted them again. This time, the mother would give him the whole box of Lego’s and he would continue playing by himself. As discussed by Mace and Roberts (1993), when individuals have two or more responses in a functionally equivalent class, they will select the response option that is perceived as most efficient in procuring or maintaining reinforcement. In Barney’s case, his failure to respond was typically an indicator that he was no longer interested in the activity and that the session should resume. In this scenario, in order to obtain what he wanted (the whole snack or the whole box of play items), it was more efficient to not respond and wait until the session had terminated than to make various requests during the session.

**Child Outcomes: Imitative Responses**

In spite of the fact that imitative responses were displayed through various
communication modes (gestures/manual signs, AAC, or vocal/verbal), most imitative behaviors seemed to occur in a verbal/vocal modality. The repetition of a word or group of words just spoken by another person defines what is conceptualized as *immediate echolalia* (Rydell & Prizant, 1995). While some researchers view immediate echolalia as a pathological behavior, others have considered it as a path to the development of functional speech in individuals with ASD (NRC, 2001).

The combination of visual graphic and verbal communication in AAC interventions have been reported to enhance the frequency of imitative verbal responses in a study conducted by Charlop-Christy and colleagues (2002). Contrastingly, in the current investigation, no consistent findings were observed across participants. While Charlie seemed to increase the frequency of this behavior in some routines, Kevin appeared to decrease it in others. Jason presented no changes, while Barney showed no clear trend in the overall use of imitative responses.

**Child Outcomes: AAC Use**

The four child participants increased their frequencies of AAC use following intervention in at least one target routine. Within subject variability was, nonetheless, observed in these outcome rates. As discussed by Ganz and Simpson (2004), variations in the mastery of picture-based AAC system use may be due to differences in the individual’s cognitive levels. Cohen and Le Normand (1998) have suggested that individuals who suffer from epilepsy are likely to display severe cognitive and language delays. In the current investigation, Barney’s degree of mental retardation and history of chronic seizure disorder may have negatively impacted his ability to use the pictures. Although Kevin and Jason were also reported to have some degree of mental retardation, Barney seemed to be functioning at a lower level. When comparing the AAC outcomes of the four participants, Barney displayed the most timid gains. This, however, does not suggest that he was incapable of learning to use the symbol system, but perhaps required more time to learn. As discussed in the research literature, individuals with severe mental retardation and developmental levels in the early representational stage have the capacity to acquire symbolic communication (Paul, 1998; von Tetzchner et al., 2004).

**Child Outcomes: Verbal and Vocal Responses**

The rate of verbal and vocal responses increased for all participants following intervention in at least one routine. The functions of these communicative acts, however, seemed
to vary across participants. The two subjects that were primarily nonverbal (Charlie and Jason) appeared to begin using verbal/vocal responses in an echolalic form, with no clear communicative functions. On the other hand, Kevin (who had unintelligible speech) and Barney (who had limited functional communication) seemed to demonstrate greater gains in the functional use of verbal communication. These findings are consistent with a study conducted by Schwartz and colleagues (1998). In that study, students that had 5 or more verbal words at the beginning of the training showed little or no speech growth, whereas the participants with greater speech production showed superior gains.

**Child Outcomes: Gestures and Manual Signs**

Kevin and Jason demonstrated increase in the use of gestures in at least one routine following caregiver treatment. Kevin used primarily manual signs, such as “more”, “help”, and “please” during the dinner routine. He typically combined these signs with verbalizations/vocalizations or with the AAC system. When requesting his mother for more hash brown, for instance, he would often point to the symbol of “more” on his placemat, verbalize the word, and produce its manual sign.

Jason, on the other hand, used primarily contact gestures to request or show items of his interest during both play routines. After completing a puzzle Jason would typically point to the puzzle pieces, requesting the caregiver to label them. These gestures were, at times, emitted in combination with vocalization. As the mother verbally named the puzzle pieces, Jason would often mimic her mouth movements without verbalizing the words, but making brief sounds. Previous investigations have reported that signs may function as self-prompts for vocalization (Remington & Clark, 1983; Tincani, 2004). The use of gestural responses may, in Jason’s case, have had a similar function.

**Social Validity**

**Caregiver Perception**

The three caregivers that concluded the study seemed satisfied with the intervention. One of the factors that possibly affected caregiver positive perception was parental participation in this investigation. Studies have suggested that family’s active involvement in AAC interventions encourage AAC acceptability and use (Angelo et al., 1997; Angelo, 2000; Berg, 2003;
Blackstone & Hunt Berry, 1987; Parette & Angelo, 1996;). The research literature has additionally indicated that parental failure to comprehend the purpose of alternative system may have detrimental effect on parent perception (Berry, 1987). Misleading assumptions such as the idea of speech being hindered by the use of aided and unaided devices is an example of a detrimental effect commonly discussed in the AAC literature (Berry, 1987; Beukelman & Mirenda, 1992; Romski & Sevcik, 1993).

Parents in the current study reported that the use of the AAC device did not represent a threat to the development of speech. In fact, the three caregivers reported that their children had become better communicators following the introduction of the picture-based system. This finding is consistent with the AAC studies analyzed in this report (Bernard-Opitz et al., 1999; Hamilton & Snell, 1993; Magiati & Howlin, 2003; Stiebel, 1999), where parents reported general satisfaction with their children’s communication outcomes subsequent to the AAC interventions.

**Limitations**

Several limitations were encountered in this investigation. First, as in any intervention “package”, determining the “appropriate” levels of each specific parent behavior is a challenging issue with no clear answers (Tannock & Girolametto, 1992). It is, therefore, unfeasible to determine if the child participants would have different results in the frequency of initiations and responses, imitative behaviors, or used different modes of communication if the caregiver had applied the strategies in different doses.

The reduced number of participants included in the present study limits the generalizability of the findings encountered. In this context, replications of the procedures used in this investigation are imperative. As suggested by Loningan, Elbert and Johnson (1998), nine replications of a study should be required for effectiveness of an intervention to be “well-established”.

The experimental design used in the current investigation failed to control for some factors affecting internal validity. Child communication gains could, for instance, be attributed to maturational factors, rather than caregiver strategy use. Additionally, other social partners, such as the child’s siblings may have contributed for the child’s communication gains across time. In some home visits, for instance, the experimenter and the research assistants observed that Charlie and Jason’s siblings began applying the intervention strategies following caregiver training. They
would typically use the system to communicate with their brothers, or use some of the Environmental Arrangement procedures, such as providing limited amount of food or play items, during the sessions. Charlie’s caregiver also indicated in her questionnaire that Charlie frequently used the AAC system to communicate with other family members in nonintervention contexts. In summary, social interactions (incorporating the AAC system) with other communication partners may have contributed to the child participant’s communication gains.

**Implications for Future Studies and Interventions**

As in concurrent AAC investigations (Hamilton & Snell, 1993; Stiebel, 1999), this study indicated that a hybrid approach, where a combination of different naturalistic teaching strategies are used, can be highly effective at promoting child communication gains. Notwithstanding the importance of this finding, future investigations should separately examine the effects of each of the caregiver teaching procedures used in the child’s responses. Teaching each caregiver intervention technique sequentially, rather than simultaneously could possibly resolve this issue.

The modes of communication employed by an AAC user is strongly influenced by the communicative function being expressed, the context of the interaction, and the social partners involved (Blackstone & Hunt Berg, 2003; Light et al., 1985; Romski & Sevcik, 1996). Most of these data come from studies involving individuals with cerebral palsy, mental retardation, and severe physical disabilities (Blackstone, 1999; Blackstone & Hunt Berg, 2003; Light et al., 1985; Romski & Sevcik, 1996). Prospective studies should focus on analyzing the types of communicative functions utilized by persons with autism using AAC systems. Future investigations could additionally verify the impact of social partners on this population’s use of aided and unaided modes of communication.

With the purpose of addressing the needs of each caregiver-child dyads, the interventionist conducted interviews with the primary caregivers and performed observations in each family’s homes. Despite the importance of these sources for designing personalized intervention plans, other social partners, such as extended family members, persons from the community that interacted with the dyads, and even other representatives of the individuals’ culture were not included in this analysis. Within an *Ecological System Approach* (Bronsfenbrenner, 1992), in order to comprehend the behavior patterns of an individual, it is essential to regard not only his/her direct Microsystems, but also the general macrosystem. In other words, consider the characteristics of the caregiver and child’s culture, referencing their
belief systems, customs, and life-styles. As discussed by Parette and colleagues (2002), for instance, multiple members may share child rearing in African-American families. This indicates that other communication partners, such as siblings, grandparents, or even cousins should be actively involved in intervention programs. In the current study, Jason, who lived with his mother, grandparents and sister and was inserted in a typical African-American community could have better benefited from the intervention if other social partners were involved. Prospective studies should focus on designing interventions that address the cultural characteristics of the families involved.

Conducting intervention in the family’s natural environment may favor the active involvement of other important social partners. In the current study, Charlie and Jason’s siblings appeared to play two important roles in the intervention process: (a) as co-interventionists and (b) as models to the child-participants. Although these children did not receive any formal instruction on the use of the teaching strategies, they were observed implementing the techniques during some home visits. This suggests that they probably learned the strategies by observing the caregiver and/or listening to the researcher’s instructions during the visits. Additionally, these siblings also functioned as good role models to the child participants. In many instances, they used the communication system and other modes of expression during the caregiver intervention sessions. These findings suggest that intervention effects may be enhanced when the natural home environment is used as the intervention scenario. In these practices it is recommendable that AAC systems be available to all individuals participating in the interaction.

As previously discussed, Kevin showed disinterest in the target play routine (playing on the computer) approximately 2 months following the initiation of the study. As a consequence, the number of intervention sessions conducted had to be reduced. To solve this problem more than one target routine was selected for Barney. When he showed disinterest in engaging in one activity, his mother presented him with other choices. This procedure seemed successful at maintaining an optimal number of sessions for data analysis. Future investigators should focus not only in selecting additional target routines, but also generalization contexts.
CONCLUSION

The current investigation provided evidence that caregivers of children with ASD can successfully learn to use naturalistic teaching strategies combined with the use of visual-graphic systems of communication in the home environment. The teaching procedures used in this study were successful at promoting generalization of caregiver strategy use across routines.

As an effect of the caregiver-implemented intervention, the 4 child participants in this study increased their frequencies of turn-taking communicative behaviors and learned to express themselves using an aided system of communication across trained and untrained routines. These participants additionally increased their frequencies of verbalizations/vocalizations in at least one routine, while two children additionally increased their use of gestures/manual signs. No consistent trends were detected for child use of imitative responses.

Social validation data indicated that the three caregiver-participants that concluded the study were satisfied with the intervention program and perceived positive changes in their children’s communication using the AAC system. Future studies should focus on investigating the effects of caregiver implemented strategies on the communicative functions used by children with ASD using aided and unaided modes of expression.
APPENDIX A
HUMAN SUBJECTS COMMITTEE APPROVAL
APPROVAL MEMORANDUM
Date: 4/26/2004

To: Debora Nunes
310-01 Pennell Circle
Tallahassee Fl 32310

Dept.: SPECIAL EDUCATION & REHABILITATION COUNSELING

From: John Tomkowiak, Chair

Re: Use of Human Subjects in Research
Enhancing the use of augmentative communication systems of children with autism through caregiver-implemented naturalistic teaching strategies

The forms that you submitted to this office in regard to the use of human subjects in the proposal referenced above have been reviewed by the Human Subjects Committee at its meeting on 4/14/2004. Your project was approved by the Committee.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals which may be required.

If the project has not been completed by 4/13/2005 you must request renewed approval for continuation of the project.

You are advised that any change in protocol in this project must be approved by resubmission of the project to the Committee for approval. Also, the principal investigator must promptly report, in writing, any unexpected problems causing risks to research subjects or others.

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols of such investigations as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Protection from Research Risks. The Assurance Number is 1RB00000446.

cc: Mary Frances Hanline
HSC No. 2004.226
INFORMED CONSENT

PARENT AGREEMENT TO PARTICIPATE IN THE INVESTIGATION

Project title: Enhancing the use of augmentative communication systems of children with autism through caregiver-implemented naturalistic teaching strategies

You and your child are being invited to participate in a research project described in this form below. This research project is governed by the rules of both the federal and government and Florida State University. These rules require that you give your signed agreement for participating in this project. This research project is being conducted by Debora Nunes, M.A., Special Education, under the guidance of Mary Frances Hanline, PhD, who is the Chair of the Department of Special Education and Rehabilitation Counseling Services at Florida State University. For further information, please contact Debora Nunes at (850) 644-3408/577-1370 or Mary Frances Hanline at (850) 644-4880. If you have questions about your rights or concerns regarding participation in this project, please contact the Human Subjects Committee at Florida State University at (850) 644-8633.

The researcher will explain to you the purpose of the project, the procedures to be used and the potential risks and benefits associated with your participation. You may ask questions to help you understand this study. The basic explanation of the study is written below. Please read this explanation and discuss any questions you might have with the researcher.

If you decide that you will participate in this project, please sign this form in the line below, in the presence of the person who explained the project to you. You will be given a copy of this form to keep.

Nature and purpose of the project: The purpose of this project is to determine the effectiveness of caregiver-implemented communication strategies to enhance the use of aided systems of communication in children with autism spectrum disorders. The estimated duration of the project is five months. Once initial interviews are completed, two visits (about 45-60 minutes long) will be scheduled each week according to your convenience and availability.

Explanation of the procedures: In the first phase of the project, the investigator will assess your child’s communication skills. In this process, you and other professionals that work with your child (e.g. speech and language pathologist) will be interviewed regarding your child’s
communication skills. In the second phase, you and your child will be videotaped interacting during daily home routines (e.g. mealtime and play). The researcher will then teach you to implement a set of communication strategies to enhance your child’s communication abilities. All sessions will be videotaped in order to provide the caregiver with feedback and for purposes of data collection.

Discomfort and risk: These procedures do not involve activities that would cause discomfort to you or your child or put you at any risk. However, if you or your child should become upset with involvement in the study, you can decide to withdraw from the study at any time.

Benefits: You and your child may benefit from this project in many ways. First, there is a possibility of learning strategies that will enhance your child’s communication abilities. Second, the results of this study will provide empirical evidence of the effectiveness of intervention procedures within the natural environment. At the termination of the project, the researcher will provide a written summary of the major findings of the study.

Confidentiality: All records relating to his project will remain confidential, to the extent allowed by law. Videotapes that are used for data coding and analysis will be kept in a locked office in the Department of Special Education and Rehabilitation Counseling Services of Florida State University. Only the researcher, a graduate assistant, and the researcher’s major professor will have access to these tapes. All records will be maintained for a minimum of 7 years. After that time, written documents will be shredded and videotapes will be bulk erased.

Refusal/Withdrawal: At any time during your participation in this study, you will have the opportunity to refuse participation or withdraw from the study at any time without prejudice or effect on you.

Risks: We do not expect any unusual risks as a direct result of participation in this study, as the intervention procedures involve standard clinical procedures.

Videotaping: Your child will be videotaped interacting with you in the home environment. During the study, these videotapes will be kept by the project staff in a locked room at the Department of Special Education and Rehabilitation Counseling Services at Florida State University. All records will be maintained for a minimum of 7 years. After that time, written documents will be shredded and videotapes will be bulk erased.
These videotapes will be accessible to the research staff, unless otherwise specified by you. We may ask you to use segments of these videotapes for educational purposes; however this is optional.

I ACKNOWLEDGE THAT I HAVE READ AND FULLY UNDERSTAND THE ABOVE EXPLANATION OF THE PROJECT THAT ALL OF MY QUESTIONS HAVE BEEN SATISFACTORILY ANSWERED, AND I GIVE PERMISSION FOR MY CHILD TO PARTICIPATE IN THIS RESEARCH PROJECT.

_____________________________________________ Date
Signature of Parent

I GIVE MY PERMISSION TO USE THE VIDEOTAPES FOR EDUCATIONAL PURPOSES SUCH AS CONFERENCES, PRESENTATIONS AND UNIVERSITY CLASSES.

_____________________________________________ Date
Signature of Parent

I CERTIFY THAT I HAVE EXPLAINED FULLY TO THE ABOVE PARENT THE NATURE AND PURPOSE, PROCEDURES, POSSIBLE RISKS AND POTENTIAL BENEFITS OF THIS RESEARCH PROJECT.

_____________________________________________ Date
Signature of Investigator
APPENDIX B
CODER INSTRUCTIONS, DATA CODING SHEETS, AND TREATMENT FIDELITY CHECKLISTS
## SELECTION OF CODING SEGMENTS

**Participant:**

**Coder:**

**Date:**

**Time:**

**Routine:**

<table>
<thead>
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<th>Time</th>
<th>Segment</th>
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**Segments to code:**

**Scale:**

1 – The caregiver does not reference the child, communicating primarily with the interventionist or other people in the room.

2 – The caregiver interacts with the child using eye-gaze, gestures, verbalizations or vocalizations in at least one episode.

3 – The caregiver interacts with the child using eye-gaze, gestures, verbalizations or vocalizations in 2 – 3 episodes.

4. - The caregiver interacts with the child using eye-gaze, gestures, verbalizations or vocalizations in 4 - 6 episodes.

5 - The caregiver interacts with the child using eye-gaze, gestures, verbalizations or vocalizations in more than 6 episodes.
<table>
<thead>
<tr>
<th>Time</th>
<th>Caregiver</th>
<th>Child response type</th>
<th>Child mode</th>
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<tr>
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<td>RA</td>
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<td>Mo</td>
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<td>AAC verb.</td>
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Communication Turn: Initiation (I) and Response (R)
Treatment Fidelity Checklist: Model 1 (1st training session)

Name: __________________________ Date: _________________

Session: ________________________ Child/caregiver:_______________________

Please rate the researcher’s behavior during the caregiver training.

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>1) The researcher defined the teaching strategy to the caregiver.</td>
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<td>2) The researcher modeled the strategy to the caregiver.</td>
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<tr>
<td>3) The researcher discussed the strategy with the caregiver.</td>
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<td>4) The researcher gave the caregiver a handout with a written description of the strategy.</td>
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<td>5) The researcher asked the caregiver to provide 2 examples of the strategy using her/his own words.</td>
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<tr>
<td>6) The caregiver practiced the use of the strategy with the researcher playing the role of the child.</td>
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<td>7) The researcher gave the caregiver a cheat-sheet and requested her/him to interact with the child during the target routine.</td>
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<tr>
<td>8) The researcher provided feedback to the caregiver during the training of the target strategy.</td>
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### Treatment Fidelity Checklist: Model 2 (training sessions)

**Name:** __________________________  **Date:** _________________

**Session:** ________________________  **Child/caregiver:** _______________________

Please rate the researcher’s behavior during the caregiver training.

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td><strong>1) Before the session:</strong> The experimenter asked the caregiver to practice the use of the strategies with the child during the target routine.</td>
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<tr>
<td><strong>2) After the session:</strong> The experimenter provided feedback to the caregiver regarding the application of the teaching strategies.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3) After the session:</strong> The experimenter asked if the caregiver had any questions and provided suggestions for the following session.</td>
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</table>
APPENDIX C

CAREGIVER TRAINING PROTOCOL AND TRAINING MATERIALS
Caregiver Training Protocol

Caregivers will be trained to apply the communication intervention strategies by the researcher, a special educator. Steps 1 to 4 will occur in the first training session. Steps 3 to 4 will occur in the remaining experimental sessions. A criterion for each step in the training protocol will determine training progress. Steps 1 to 4 of this training protocol will be implemented in the first session of the intervention phase of the target routines, and/or when caregiver use of, at least, two of the strategies fall below baseline levels for three consecutive sessions. Steps 3 and 4 will be implemented in the remaining sessions. This training protocol will last approximately 20 minutes. The training will not continue until the caregiver reaches criterion for each step.

Step 1

- The researcher will define, model and discuss the teaching strategies with the caregiver. The caregiver will be given a handout providing the definition of the procedures and examples of its use.

*Criterion:* The caregiver will describe the strategies using her/his own words and provide two examples.

Step 2

- The experimenter will give the caregiver a “cheat sheet” (with a summary of the strategies). Then, the researcher will play the role of the child and ask the caregiver to play her/his role in a simulation of the target routine.

*Criterion:* The caregiver will apply the strategies at least 2 times with researcher playing the role of the child.

Step 3
The researcher will ask the caregiver to practice the use of the strategies with the child during the target routine.

*Criterion:* The caregiver will apply, at least, two of the strategies two times with the child during the target routine.

**Step 4**

- Following the caregiver-child interaction, the experimenter will provide feedback regarding the use of the strategies, provide suggestions for the following intervention session and ask if the caregiver has any questions.

*Criterion:* The caregiver will ask for any clarifications, if needed.
CAREGIVER INSTRUCTIONAL MATERIAL

Project: Enhancing the use of augmentative communication systems of children with Autism Spectrum Disorders through caregiver implemented

Naturalistic Teaching Strategies

Naturalistic Teaching Strategies

1. **Environmental Arrangement** – is a procedure where the physical environment is arranged in a way that entices the child to communicate in order to access desired objects or actions.

Initially, place the AAC system within your child’s reach

Then, use one of the following:

1) Place a desired toy/food within the child’s sight, but out of reach.

   Ex 1: put the cookies on your side of the table, where the child can see, but not reach them.

2) Put insufficient amount of food/drink.

   Ex 2: give only half of a cookie or a small amount of juice when the child requests it;

3) Provide insufficient pieces of a game or material used to complete an activity.

   Ex 3: give the child 2 or 3 pieces of a puzzle and keep the remaining pieces in your possession.

4) Sabotage the activity

   Ex 4: turn off the radio “by accident” when the child is listening to music.

2) **Mand/question** – is a procedure where the social partner identifies the child’s focus of attention, mands a response or asks a question.

   Ex 1: The child looks at the cookies. The caregiver says” “Do you want a cookie?”

   Ex 2: The child reaches for the cookie. The caregiver says: “Tell me what you want”
Ex 3: The child looks at the food on the table. The caregiver provides some options: “Do you want the cookie or the juice”.

3) **Question/Comment with AAC** – is a procedure where the social partner identifies the child’s focus of attention, asks a question or makes a comment while pointing to the pictures on the AAC system.

   Ex 1: The child looks at the cookies. The caregiver points to the pictures of “want” and cookie on the AAC board and says” “Do you want a cookie?”

   Ex 2: The child looks at the food on the table. The caregiver points to the pictures of “want”, “cookie” and “juice” and says “Do you want the cookie or the juice?”

   Ex 3: the child is eating the cookie. The caregiver points to the picture of the cookie on the communication board and the picture of “yummy” and says: “They cookie is yummy!”.

4) **Model** – is a procedure where the social partner provides a model for the child to imitate, when the child fails to respond to a request or command using the AAC system.

   Ex 1: The caregiver physically guides the child to point to the picture of the cookie. During this action, the caregiver verbalizes the appropriate response “I want cookie”.

   Ex 2: The caregiver physically guides the child to get the picture of the cookie and give it to her/him. During this action, the caregiver verbalizes the appropriate response “I want cookie”.
1) Environmental Arrangement: Did you put the food/toys out of reach? Did you provide only a small amount?

2) Mand/question: “Tell me what you want” or “Do you want the cookie or the cake?”

3) Question/Comments w/AAC. “Do you want a cookie” or “I like cookies!” (indicate pictures on AAC);

4) Model – get the child’s hand and model the response. Don’t forget to say the words while you point/take the pictures on the AAC.
Project:

Enhancing the Use of Augmentative Communication Systems of Children with Autism
Through Caregiver-Implemented *Naturalistic Teaching Strategies*

Dear Parent,

Enclosed are two (2) scales to evaluate the implementation of the AAC program:
(1) Caregiver Survey
(2) Parent satisfaction questionnaire

Your feedback is essential for making any pertinent changes or adaptations in future projects.

THANK YOU for participating in this project!
It’s been great to work with you!

Sincerely,

___________________
Debora Nunes
Caregiver’s Survey

Type of AAC used by the child

(  ) Communication Board/Book   (  ) Picture communication cards (  ) Both

As a result of using AAC:

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Disagree</th>
<th>Neutral</th>
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</thead>
<tbody>
<tr>
<td>My communication with my child is better</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel the AAC restricts communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>My child has fewer communication breakdowns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel the AAC device carries a stigma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel the device is a burden</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am positive about my child using the AAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>My child can convey positive emotions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>My child can convey negative emotions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>My child can express physical well-being</td>
<td></td>
<td></td>
</tr>
<tr>
<td>My child can express needs and wants</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

# Parent satisfaction questionnaire

**Questions**

<table>
<thead>
<tr>
<th></th>
<th>Not much</th>
<th></th>
<th></th>
<th></th>
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</tr>
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<tbody>
<tr>
<td></td>
<td>Not easy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>very easy</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. How easy is it to learn to use the **naturalistic teaching strategies**?

2. How easy is it to use the **AAC system**\(^2\) when implementing the **naturalistic teaching strategies**\(^3\)?

3. How easy is it to incorporate the **naturalistic strategies** within your routines?

4. How much do you think this treatment helped your child use the **AAC system**?

5. How much do you think this treatment helped your child become a more successful communicator?

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Note: 1 = not easy/ not much help; 2 = somewhat easy/ somewhat helped; 3 = mildly easy/ mildly helped; 4 = moderately easy/ moderately helped; 5 = very easy/ helped very much

\(^2\) **AAC system** – Communication board or picture communication cards

\(^3\) Naturalistic teaching strategies – *techniques taught by the experimenter:*

*(Mand, Model, Mand with AAC, Environmental Arrangement)*
REFERENCES


BIOGRAPHICAL SKETCH

EDUCATION

• Doctor of Philosophy, Florida State University, Tallahassee, Florida, U.S.A. Major: Special Education, 2005


• Bachelor of Arts, Universidade Federal do Rio de Janeiro, Rio de Janeiro, R.J., Brazil Major: Psychology, 1998

FELLOWSHIPS/ AWARDS

• Ph.D. Fellowship from CNPq/ Brazil, 2001 – 2005

• Florida State University Dissertation Research Grant Award – February, 2004

• M.A. Fellowship from CAPES/ Brazil, 1998 – 2000

GRANT/ RESEARCH ACTIVITIES

• Autism Spectrum Specialized Education and Training (ASSET) – Department of Communication Disorders and Department of Special Education and Rehabilitation Counseling Services – Florida State University –: Mentor Coordinator 2004 – 2005


• Summer Reading and Literacy Camp for Children with Autism Spectrum Disorders - Department of Special Education and Rehabilitation Counseling Services and Department of Communication Disorders – Florida State University. Function: Teacher, 2002


**UNIVERSITY TEACHING EXPERIENCE**

- Co-Instructor: *Technology for Students with Disabilities* (EEX 5245) – Department of Special Education and Rehabilitation Counseling Services – Florida State University, Fall, 2005.

- Development of Online Course *Introduction to Technology in Special Education* (EEX 5245). Department of Childhood Education, Reading, and Disability Services, Summer, 2005

- Teacher Assistant: *Family-Centered Service Delivery* (EEX 5931 – online course). Department of Childhood Education, Reading, and Disability Services, Spring, 2005

- Co-Instructor: *Assistive Technology* (EEX 5931) – Department of Special Education and Rehabilitation Counseling Services – Florida State University, Spring, 2005

- Co-Instructor: *Introduction to Technology in Special Education* (EEX 5245) – Department of Special Education and Rehabilitation Counseling Services – FSU - Fall, 2004

- Teacher Assistant: *Recent Advances in Evidence-Based Practice for Autism Spectrum Disorders* (EEX 5931-07 – online course) Department of Special Education and Rehabilitation Counseling Services – Florida State University, Summer, 2004

- Development of Course *Introduction to Technology in Special Education* (EEX 5245). Department of Childhood Education, Reading, and Disability Services, Summer, 2004

- Teacher Assistant: Assistive Technology (EEX 5931) – Department of Special Education and Rehabilitation Counseling Services – Florida State University, Fall, 2003

- Co-Instructor: Assistive Technology (EEX 5931) – Department of Special Education and Rehabilitation Counseling Services – Florida State University, Summer, 2003

- Instructor: Research Methodologies – Department of Education Universidade Severino Sombra University – Vassouras, Brazil, Summer, 2001
RECENT AND RELEVANT PUBLICATIONS


