A Comparison of Sign Request and Word Request Training For a Child With Autism

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Abstract
Delayed language acquisition is a hallmark feature of autistic disorder. This study examined the rate of language acquisition and its effects on disruptive behaviors (stereotypy, mouthing, tantrumming) in a 4-year-old child with autism. The study used a multielement design consisting of a baseline phase followed by alternation between two conditions and a final "best-treatment" phase. The two compared conditions were Total Communication Request Training (TCRT) and Word Request Training (WRT). Results identified TCRT as the best treatment for this child due to a faster rate of acquisition. No changes in problem behaviors occurred as language acquisition increased. The complex interaction between language instruction and acquisition, disruptive behaviors, and environmental conditions are discussed. Limitations to the study are discussed.

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A COMPARISON OF SIGN REQUEST AND WORD REQUEST TRAINING FOR A CHILD WITH AUTISM

A DISSERTATION
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ABSTRACT

Delayed language acquisition is a hallmark feature of autistic disorder. This study examined the rate of language acquisition and its effects on disruptive behaviors (stereotypy, mouthing, tantrumming) in a 4-year-old child with autism. The study used a multi-element design consisting of a baseline phase followed by alternation between two conditions and a final “best-treatment” phase. The two compared conditions were Total Communication Request Training (TCRT) and Word Request Training (WRT). Results identified TCRT as the best treatment for this child due to a faster rate of acquisition. No changes in problem behaviors occurred as language acquisition increased. The complex interaction between language instruction and acquisition, disruptive behaviors, and environmental conditions are discussed. Limitations to the study are discussed.
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A COMPARISON OF THE EFFECTS OF SIGN REQUEST AND WORD REQUEST TRAINING METHODS ON LANGUAGE ACQUISITION AND DISRUPTIVE BEHAVIOR FOR A CHILD WITH AUTISM

Introduction

The problem to be explored in this study is two-fold. First, there is still debate among professionals regarding the role of sign language in the development of verbal communication in children with autism. Although many studies cite some success in fostering spoken language without the use of sign or other adjuncts to oral instruction, the participants often learned only single words (e.g., Barrera & Sulzer-Azaroff, 1983), possessed a foundation of verbal abilities prior to the study (e.g., Yoder & Layton, 1988), and/or rely on scripted responses lacking in spontaneity and flexibility (e.g., Schuler, Prizant, & Wetherby, 1987). The proposed study will compare the effectiveness of using speech-only instruction and Total Communication (i.e., simultaneous signs and words) to teach spontaneous communication in a child with autism. The program to be used in the study is outlined in the Signed Speech for Nonverbal Students manual (Schaeffer, Raphael, & Kollinzás, 1994). The terms Total Communication and simultaneous communication are often used interchangeably in the literature; however, for the purpose of this study, a distinction between the two methods is important. Total communication in this study is defined as the therapist using sign language to accompany spoken English in nearly all verbal interactions with the child, not only when presenting a target word. This may be contrasted with simultaneous communication, in which only words targeted for acquisition are presented in both sign and spoken language, and Signed Speech, the
child’s own simultaneous use of sign and word. *Spontaneous communication* is defined as any communication (signed or spoken) that occurs in the absence of modeled, echoic, or physical prompting, although visual access to the stimulus, discussion of the desired stimulus, or a request for information may occur.

The second problem that will be explored in this study is the effect of increased communicative ability on the frequency of inappropriate behaviors in a child with autism. Inappropriate behaviors include tantrums, and the specific behaviors defined as part of a tantrum, as well as stereotyped behaviors such as hand flapping, vocal stereotypy, and mouthing. *Tantrums* are defined as any combination of two or more of the following behaviors lasting more than 1 minute: screaming, crying, biting, flopping, kicking, or throwing things. *Stereotyped behavior* is defined as any manipulating of the hands, arms, or head in a nonfunctional manner, in the case of this study specifically, flapping of the arms. *Vocal stereotypy* is also a form of stereotyped behavior and is defined as any vocalization not emitted with the clear intent to communicate. *Mouthing* is defined as placing an inedible item in the mouth with or without the eventual intent of ingestion or placing an edible item in the mouth and then removing and discarding it prior to ingestion.

Review of Relevant Research on Autism

**Background**

Autism spectrum disorders are pervasive developmental disorders estimated to affect from 1 in 150 children in the United States (Centers for disease control, 2007). Autistic Disorder, one of the autism spectrum disorders, is characterized by delays and impairments in social interaction and communication as well as restricted, repetitive,
and/or stereotyped movements, interests, activities, and/or vocalizations (American
Psychiatric Association, 2000). In addition, symbolic or imaginative play may be
delayed. By definition, these symptoms are present before the age of 3 years old. In the
following, the term autism will be used to refer to autistic disorder.

Language Development and Impairment in Autism

Delayed and/or impaired communication is one of the core symptoms of autism
(American Psychiatric Association, 2000). Examples of this symptom include both absent
and impaired preverbal and verbal communication skills. Preverbal communication skills
that may be impaired include eye contact, gestures, facial expressions, the pursuit of joint
attention, and other attempts to communicate using nonverbal language. Verbal
communication skills that may be impaired include the ability to use fluent and
spontaneous spoken language, initiation and maintenance of conversations, and
engagement in verbal social imitation and make-believe play.

Approximately 50 percent of children with autism will remain functionally mute
in adulthood (Lord & Paul, 1987; Peeters & Gilberg, 1999, as cited in Tincani, 2004;
Schuler, Prizant, & Wetherby, 1987). After intensive speech training, the percentage of
children without functional speech may decrease to 25 percent (Lord & Bailey, 2002, as
cited in Howlin, 2006). Lerman et al. (2005) state that acquisition of spoken language
prior to age 5 is considered a good predictor of later outcomes in adaptive skills and
academic achievement. Bondy and Frost (1994) estimated that 80% of children with
autism under the age 5 enter their instructional programs with no functional
communication skills, a dismally high number when considering that Lord and Bailey
(2002, as cited in Howlin, 2006) state that it is unlikely for children with autism to
acquire spoken language if the acquisition process has not begun by the age of 6 years. For this reason, there is a small window in which a language intervention must prove effective. Further, intensive treatment is both time-consuming and expensive. Carr, Binkoff, Kologinsky, and Eddy (1978) counted over 4,460 trials to teach a 10-year-old child with autism three signs. Schaeffer, Kollinzas, Musil, and McDowell (1977) invested 20 hours per week for 2 years to teach three 6- to 7-year-old boys to speak spontaneously and create novel spoken utterances.

Communication instruction in autism

There are several available methods of communication training for children with autism. Verbal speech instruction, sign language, symbol and picture exchange, written communication, computer or electronic facilitation, and pre-recorded audio messages are all ways that have been studied and used to foster communication skills in people with autism (Howlin, 2006).

Rogers (2006) has stated, “there is currently no empirical research that the use of alternative systems will accelerate the development of spoken language compared with...focus completely on developing spoken language” [p. 167; italics in original]. Alternative systems in this context referred to the use of signs, pictures, or symbols to augment speech training. What has been shown, though, is that different children with autism learn differently and it does not appear that one method can optimally address every child’s situation (e.g., Goldstein, 2002; Tincani, 2004).

Total Communication refers to a form of language instruction that utilizes the simultaneous presentation of spoken language and sign language in nearly all interactions with the student. It has been used to teach deaf populations as well as hearing populations
with communication deficits. Total Communication, because it requires the signing of complete phrases and sentences, is often based on Signed English (SE; e.g., Casey, 1978; Layton, 1988), as opposed to American Sign Language (Amslan). Signed English uses the sentence structure of spoken English as a framework and accompanies spoken English word for word with signs so that for the listener, each word is seen and heard simultaneously. On the other hand, the sign language that accompanies simultaneous communication, which isolates the use of both sign and spoken language to words targeted for acquisition, is often based on American Sign Language (e.g., Barrera & Sulzer-Azaroff, 1983). The grammar and syntax of Amslan are distinctly different from those of spoken English, possibly threatening the fluent acquisition of either language if used to communicate phrases or complete sentences.

Simultaneous and/or Total Communication is sometimes argued against because it has been found that many children with autism selectively attend to either visual or auditory stimuli, but not both conjointly (e.g., Carr, Binkoff, Kologinsky, & Eddy, 1978; Remington & Clarke, 1983). Even when children do acquire the ability to expressively label an object, it cannot be assumed that the child can receptively identify the object or comprehend its use outside of an instructional context. Remington and Clarke (1983) taught five previously unknown words to a boy and girl with autism. After mastering the words through expressive sign, they found that the girl did not differ significantly from baseline when tested for receptive comprehension of the words, regardless of whether the words were taught in one (sign only) or two (simultaneous communication) modalities. The boy, on the other hand, demonstrated significantly improved comprehension from
baseline for words learned in the simultaneous condition but still lacked receptive knowledge of words learned in the sign-alone condition.

Layton (1988) concluded the use of sign was the common denominator in predicting which method would be most effective for autistic children with poor verbal imitation skills. Autistic children with advanced verbal imitation skills comprehended, produced, and spontaneously used more words than those with lower verbal imitation skills, regardless of whether the instruction method employed sign, speech, or a combination of the two. Remington and Clarke's (1983) research supports this finding: In their study, the child with improved comprehension following expressive language training in the simultaneous condition was previously assessed to have higher verbal imitation skills than the child who did not improve in comprehension.

Tincani (2004) compared the Picture Exchange Communication System (PECS) with signing in a 5- and 6-year-old boy and girl (respectively) with dual diagnoses of autism and mental retardation. Signs were taught by imitation of the therapist. PECS instruction was accompanied by physical prompting from a second trainer. The boy performed better with signs, whereas the girl’s performance was superior using PECS. The authors hypothesized that the girl’s weaker fine motor imitation skills interfered with her success at learning sign and stated that success in learning signs depends upon possession of at least moderately good hand-motor imitation skills. Both children, however, experienced barriers to the use of speech for communication, but consistently produced more speech when using signs. The boy became dependent upon a model prompt to initiate signing, inhibiting spontaneous requests for desired items. Further, his speech attempts decreased over the course of the study. Elimination of the model and use
of physical prompts only improved his spontaneous generation of signs but his speech continued to decrease to less than 14% of opportunities to speak by the end of the study. The authors suggested using a second trainer who provides physical prompts from behind to teach signs or starting with modeling and then moving to physical prompts. Their suggestions would help to decrease the child’s dependence on imitative prompts. The girl in the study also evidenced decreased speech expression over the course of the study. Her speech attempts dropped from 93% of opportunities initially to as low as 25%. A time delay instructional procedure increased her speech frequency to 90%. It is unclear from the study, however, how much of an effect the adjunctive systems of PECS or signs contributed the children’s spoken communication. Both children demonstrated a preference for the nonverbal modes of communication and did not appear to value oral communication. The time-consuming training, in this case involving the recommended two instructors and back-tracking to regain lost verbal skills, is one of the many barriers to effective language interventions for autism.

*Literature Review*

*Receptive Language Instruction*

Using a simultaneous treatment design comparing speech-only, sign-only, and combined speech and sign instruction modalities, Brady & Smouse (1978) found that the simultaneous use of verbal speech and sign yielded results significantly superior to speech-only and sign-only instruction when teaching receptive instructions to a 6-year-old boy with autism. The speech-only condition was actually significantly correlated with decreased performance from baseline. The three-word instructions consisted of one object, one color, and one action, from which the child was presented with a field of three
examples of each category among which to choose from. It was not noted which system of sign language the investigators used (SE or Amslan). It should be mentioned, too, that although the child already used some noncontextual speech outside of session, expressive speech related to the target stimuli was not probed. Reinforcement consisted of favorite foods and praise.

In contrast to Brady and Smouse (1978), Wherry and Edwards (1983) found no significant differences in receptive language acquisition when comparing sign-alone, speech-alone, and simultaneous communication treatments for a 5-year-old boy with autism. The authors also used a three-word instruction consisting of a color, object, and action, similar to Brady and Smouse. The authors noted that they provided soda as reinforcement unless the child preferred chips, but it is not clear how reinforcing the soda and chips were for the child.

Differences in the findings between the above similar studies could be attributed to the children’s pre-treatment language skills and the size of the word list. Wherry and Edwards’s (1983) study contained three times as many words as Brady and Smouse’s (1978) study. Also, Brady and Smouse’s participant exhibited some receptive understanding and two expressive signs but no spoken language, compared with Wherry and Edwards’s participant, who was able to speak a few phrases at the start of the study. The child’s expressive language ability in Wherry and Edwards’s study may have granted him an advantage in the speech-only condition that Brady and Smouse’s participant did not have, resulting in poorer scores in this modality. Another consideration is the total time devoted to language instruction. Brady and Smouse’s total training time during the simultaneous treatments phase of their study was approximately 10 ½ hours (21 sessions.
at one-half hour per session). It is unknown how much time was spent training in Wherry and Edwards’s study, although the authors noted that the experimental period lasted 15 days. Training may not have occurred for a long enough time for any one method to stand out from the others.

Layton (1988) determined that pre-existing verbal imitation skills also appear to influence the receptive learning capacity of children with autism. In children with weak verbal imitation skills, he found a trend for simultaneous communication to result in poorer receptive comprehension of words compared with sign-only or speech-only comprehension. Children with stronger verbal imitation skills were able to comprehend equally well using all three means. This finding is consistent with Wherry and Edwards’s results and may be one explanation for the differences in results between Wherry and Edwards's participant, who had some verbal language, and Brady and Smouse’s participant, who was completely nonverbal.

Webster, McPherson, Sloman, Evans, and Kuchar (1973) described a case study in which they used both sign and verbal cues when instructing a 6-year-old boy with autism. They reported that the child correctly responded more often when only sign was used (80% correct), compared to when the combined used of sign and speech were used (69% correct). Statistical significance of this difference was not explored in the study.

Expressive sign language instruction

Although receptive understanding of speech is better than no understanding, it barely begins to address the language and communication deficits that are so central to autism. The use of signing to teach children with autism has been popular because it is believed to tax memory less and is easier to prompt and mold than are vocalizations
(Howlin, 2006). After at least 6 months in a sign language program, 14 low functioning autistic children with no spoken language demonstrated vocabulary sizes ranging from 2 to 59 different signs (Seal & Bonvillian, 1997). The method of sign instruction used was not described in the study.

One criticism of sign is that it requires imitation skills (Bondy & Frost, 1994). There is some evidence that using modeling in sign and speech learning may actually result in prompt dependence, leading to the need for corrective back-tracking that takes both time and effort on the part of the therapist and confuses and frustrates the child (Tincani, 2004). In the Signed Speech for Nonverbal Students program, however, imitation is replaced by direct molding of the child’s hands into the appropriate sign (Schaeffer, Raphael, & Kollinzas, 1994). It was also noted by Tincani (2004) that the use of physical prompting of signs reduced prompt dependence and increased spontaneous signing.

Carr, Binkoff, Kologinsky, and Eddy (1978) taught the signs for five common foods to four nonverbal children with autism, ranging from 10 to 15 years of age. Amslan was used. For each sign, the therapist presented the object along with its verbal label. The child was expected to produce the correct sign and his hand was physically molded into the correct sign if he did not respond accurately. Following correct signing, the child received a piece of the signed for food and verbal praise. It was not determined prior to instruction, however, whether the child was motivated to obtain the signed for food item. Signs were taught one at a time and then rotated with previously mastered signs. A stimulus control assessment following instructional mastery of all five signs indicated that three of the children responded only to the visual presentation of the items and did
not respond correctly to the spoken word unaccompanied by a visual cue. The fourth child was able to respond equally competently to both visual and spoken representations of the learned signs. The children were able to generalize their learned sign labels to new therapists but it was not noted whether the children acquired pragmatic use of the labels in other settings.

Method Comparison Studies

Tact instruction. Remington and Clarke (1983) found no significant differences when comparing sign-alone and simultaneous communication instruction for a 10-year-old girl and a 15-year-old boy, both diagnosed with autism. The boy had some verbal imitation skills and the girl did not. The purpose of the study was not to obtain spoken language from the children; rather, the authors were interested in increasing the speed of acquisition of signed expressive object labels. Five previously unknown words were taught using sign alone and five other previously unknown words, matched in difficulty, were taught using simultaneous communication. Modeling was used to teach the signs, followed by physical prompting to correct incorrect responses. Neither method was found to result in significantly faster acquisition of words than the other. Although statistically insignificant, word mastery in simultaneous communication required 8 to 9 percent more trials than word mastery in the sign-alone condition. The items were not based on child-determined interests but were random words such as *rifle* and *jug*, presented in two-dimensional representations. Through alternate removal of the visual picture and spoken object label it was determined that the boy signed correctly upon presentation of either the picture or verbal label but the girl relied solely on the presence of the picture.
In Barrera, Lobato-Barrerra, and Sulzer-Azaroff's (1980) study, a 4 ½-year-old boy was taught under the conditions of speech-only, sign-only, and simultaneous communication. The boy was observed to verbalize four words prior to the treatment, although none of the words were used in an appropriate context. Familiar objects were separated into three groups and matched for difficulty. Each group of words was then assigned to be taught using one of the three instruction methods. To teach the signs the therapists used physical prompting followed by modeling as prompting was faded. Verbal responses were taught by using modeling and chaining of sounds. The therapist initiated all training sessions and reinforcement for correct answers consisted of desired food and praise. In contrast to Remington and Clarke’s study, the results indicated that targets taught with simultaneous communication were learned at a significantly faster rate than targets taught in the other two conditions; after 2 weeks, the child was able to speak and/or sign 11 targets in 3 days of using the simultaneous communication method. The child in Barrera et al.'s study responded with combined sign and vocals in 47 percent of the simultaneous communication words by session 14 of the study. When new targets were introduced during session 15, however, the child’s simultaneous responses decline to 23 percent of total responses. The speech-only condition was found to be the second best treatment, although not significantly different from the sign-only condition. In the speech-only condition, however, the child was only able to verbally approximate four of the 10 total words, all simple and monosyllabic (e.g., cat, tie). It was implied in the study that the child did not produce independent vocal responses. Parents and teachers noted that the child spontaneously generalized the use of learned signs to other times during the day.
The difference between Barrera, Lobato-Barrerra, and Sulzer-Azaroff’s (1980) and Remington and Clarke’s (1983) findings regarding the efficiency of simultaneous communication training compared with uni-modal methods may be influenced by the children’s familiarity with the words prior to the study. Barrera et al. state that the list of familiar words was constructed by the child’s parents and teachers. Therefore, the words had likely been spoken to the child several times, possibly even several times per day. Baseline knowledge of the words was not assessed; however, the parents’ and teachers’ construction of the word list also suggests that during the study the child may have been exposed to the words in other settings, outside of training sessions, thus fostering generalization to his natural setting. Remington and Clarke, on the other hand, took baseline measures of both receptive and expressive knowledge of the target words and eliminated any suspected known words. Another factor possibly affecting the differing results between the two studies is the age differences between the children. Barrera et al.’s participant was still younger than age 6, identified by Lord and Bailey (2002) as the cut-off for beginning language acquisition. The two participants in Remington and Clarke’s study exceeded this cut off by at least 4 years, consistent with their increased difficulty in learning language through any modality. Further, the method of instruction differed between the two studies. Initial sign instruction in Remington and Clark’s study consisted of modeling and imitation, whereas Barrera et al.’s initial instruction for sign responses utilized physical prompting.

Barrera and Sulzer-Azaroff (1983) also studied three autistic girls who demonstrated minimal spontaneous and functional expressive language. They compared speech-only training with simultaneous communication training using words matched for
difficulty and reinforcement potential. Similar to the above studies, they also focused on tact learning, used a discrete trial approach, and reinforced correct responses with social praise and edibles. Incorrect responses were additionally punished with a 15-second timeout. The simultaneous communication technique that they used involved modeling the word and Amslan sign. When incorrect signing was accompanied by correct vocal responses, the signs were corrected after the delivery of the reinforcement. Correct signing unaccompanied by the correct vocalization resulted in praise for the signing and modeling of the correct sign-vocalization combination. Results showed that more speech trials were required to meet criterion compared with simultaneous communication trials. At its largest discrepancy, an average of 82.4 trials per target to mastery were required during speech training compared with 60.1 trials per target during simultaneous communication training. One child did not learn any of the words targeted for speech-only instruction but was able to learn all 10 targets in speech and/or sign in simultaneous communication. The two other girls had only learned one speech-only target by the time they met criterion for five targets in simultaneous communication. Training was discontinued early with one of the children due to an increase in disruptive behavior.

*Functional or manding instruction.* In both typically developing and autistic children, emerging language often first serves a manding function. The use of tacts and unrelated reinforcement to teach language, as the above studies did, may not be relevant or reinforcing enough to motivate a child to attend to and discriminate the correct answer. Barrera and Sulzer-Azaroff's (1983) experience of increased disruptive behaviors during tacting instruction in one of their participants may indicate that the demands of the language acquisition trials did not outweigh the rewards for correct responding. Further,
the reinforcement and punishment procedures used by Barrera and Sulzer-Azaroff (1983) assume that the child was motivated to say the word to get the reinforcer and that the child desired attention from the teacher.

None of the studies described above employed a reward preference assessment prior to initiation of teaching trials and none taught words that represented objects known to be intrinsically motivating to the child under study. Koegel, Koegel, and Surratt (1992) found that language teaching based on motivating stimuli that are naturally reinforcing resulted in significant decreases in disruptive behavior during language learning in addition to increased acquisition of the language targets. Lerman et al. (2005) conducted functional analyses on the most frequent utterances of unclear function for four children with autism. The children ranged in age from 6 to 12 years old and exhibited minimal functional speech. The authors determined that three of the four children were using their language for manding purposes.

In addition to studying receptive comprehension as described above, Layton (1988) also compared the production and spontaneous use of words in children divided into groups by their high or low verbal imitation skills. The children were taught language in one of four different conditions consisting of speech only, sign only, simultaneous speech and sign, and alternating speech and sign equally. Single words or two-word phrases that were functional or highly interesting were taught to the children in order to increase their motivation to communicate. Signs were taught primarily using Signed English. Layton found that 3 months later, the children were able to retain the words learned regardless of the method by which they learned them. Whereas high verbal imitators were able to produce and spontaneously use the targets equally effectively in all
conditions, children with lower verbal imitation skills produced responses reasonably well only in conditions that included signing. Spontaneous use was defined as child-initiated language. There were no significant differences between any of the conditions in the low verbal imitation groups regarding the number of words that were spontaneously generated. Although Layton measured spontaneous use of words, there was no information on whether the children used speech, sign, or both when producing words learned through simultaneous training. Layton determined that no specific modality of treatment could be identified as preferred, aside from the finding that low verbal imitators responded better to a modality that incorporates the use of sign. Generalization of the language to other settings did not occur, illustrating that even when learning highly motivating object labels, children with autism still have difficulty with pragmatics.

Facilitation of the transition from sign to spontaneous speech and generalization. Lord and Paul (1987) pointed out that the previously cited 50 percent statistic regarding autism and functional mutism does not address the quality and integration of the spoken language in the lives of the other verbal 50 percent of the autistic population. Few of the above studies followed language instruction beyond the acquisition of single words, and few measured true child-initiated spontaneous expression as indicated by reference to an item when it is not visibly present (Barrera & Sulzer-Azaroff, 1983; Remington and Clarke, 1983). Further, many studies neglected to indicate whether the children were eventually able to communicate using spoken language unaccompanied by signing (e.g., Layton, 1988; Remington and Clarke, 1983; Yoder and Layton, 1988).

Few studies sought to specifically measure spontaneous communication in children with autism (Goldstein, 2002). Schuler, Prizant, & Wetherby (1987) stated that
spontaneous speech or vocalization increases in approximately one-third to one-half of nonverbal people with autism who learn communication through alternative methods. Even when children with autism acquire functional speech, though, they often respond in a scripted manner rather than with flexible spontaneity and true comprehension. The importance of spontaneous language use cannot be understated. The ability to generate spontaneous speech allows the child more control over his or her environment. After teaching Total Communication to four mothers of children with autism, Casey's (1978) study yielded behavioral improvements that were maintained or even further increased at 3-month follow-up. Even without any specific instruction in either verbal or signed communication, the exposure to Total Communication was also associated with increases in spontaneous verbal language.

Barrera and Sulzer-Azaroff (1983) demonstrated superior performance using simultaneous communication to teach single sign and/or word expressive labels. In the final session of training, up to 80 percent of words were still labeled using Signed Speech and it was not stated that spoken language was an eventual goal. Increased spontaneous responding was noted over the course of the study, with most spontaneous responses occurring through sign only. Yoder and Layton (1988) found that simultaneous communication, compared with sign-only instruction, yielded more variety in spontaneous and child-initiated spoken language. They also found that after controlling for level of verbal imitation ability, children with the sign-only instruction demonstrated a significantly smaller spontaneous vocabulary than the children receiving instruction in speech only, simultaneous communication, or alternating speech and sign. Children in these latter three conditions did not differ significantly from each other with regards to
spontaneous vocabulary size. Yoder and Layton noted only spoken language but did not note whether the children taught in simultaneous communication continued to accompany their spoken language with signing.

Communication using full sentences and spontaneous spoken language are two of the ultimate goals of the Signed Speech for Nonverbal Students program that was used in this study (Schaeffer, Raphael, & Kollinzas, 1994). The program is based on the research of Schaeffer, Kollinzas, Musil, and McDowell (1977). Schaeffer et al. (1977) described a long-term plan for the development of spontaneous speech using Total Communication. Three 4- to 5-year old boys with autism, previously nonverbal, acquired the ability to produce spontaneous, generalized, and novel sentences over a 2-year period, first in sign, then in Signed Speech, then speech alone. The training began with separate instruction in verbal imitation and sign for 3 to 4 months, followed by the use of Signed Speech for several months, followed by child-initiated fading of the use of signs and transition to spontaneous speech. Because of the extended period of time that Schaeffer et al. spent working with the children, it is unknown whether the other studies above, typically conducted in less than 1 month, would have fostered similar levels of spontaneously generated and novel language.

Generalization. Many studies neglected to mention whether generalization of language skills to other settings occurred (e.g., Barrera & Sulzer-Azaroff, 1983). It cannot be assumed that children with autism will spontaneously generalize language learned in structured didactic settings. The more settings in which a child learns to apply communication skills to impact his or her environment, the more likely it is that s/he will make language a part of his or her everyday routine (Howlin, 2006). Unfortunately,
research is focused more often on the number of signs or words acquired with less emphasis on the child’s pragmatic ability to spontaneously use and integrate the signs or words into daily life and how the words might contribute to the quality of life for the child (Howlin, 2006). Layton (1988) stated that generalization to other settings did not occur in his study and described one child who did not use any of the learned words until he again saw the therapist in the original training setting at the 3-month follow-up.

The role of natural versus didactic teaching. It should not be a surprise that many of the above studies failed to mention generalization or only mentioned that generalization did not occur (e.g., Barrera & Sulzer-Azaroff, 1983; Layton, 1988). Didactic teaching, the highly structured procedure used in many of the above studies, has been associated with difficulty generalizing learned skills to the everyday environment and a loss of skills after intense instruction is removed. Naturalistic teaching, on the other hand, is associated with spontaneous language use and continuing gains after intense instruction has ended (Rogers, 2006). Rogers (2006) reported that the natural consequences of interacting with the environment tend to create intrinsic motivation for children with autism to continue engagement even when it is no longer required to access tangible reinforcement. Naturalistic teaching methods focus on child-initiated interactions that obtain for the child reinforcement relevant to the interaction. Using natural motivators in the child’s environment can increase the likelihood that the child will be motivated to spontaneously use speech or signs when confronted with unfulfilled needs or desires. Smith (2001, as cited in Rogers, 2006) states that naturalistic methods should even be incorporated into primarily didactic speech programs due to the noted difficulties with generalization. Although children in Carr, Binkoff, Kologinsky, and Eddy’s (1978)
study were noted to be able to generalize their language skills to new therapists, because their acquisition occurred in a highly structured didactic setting, it was not stated and cannot be assumed that the children were able to generalize their skills to other settings. Layton (1988) reported efforts to facilitate generalization of language use during training and incorporate pragmatic application of the learned words; however, some children still did not generalize the new language skills to other settings. Aside from Schaeffer, Kollinzas, Musil, and McDowell (1977), few other reviewed studies attempted to teach and generalize words that were useful for the child’s functioning in the environment simply for the sake of increasing the child’s ability to communicate with others.

More commonly, language generalization becomes a priority when a child’s disruptive behavior interferes with others’ functioning or the child’s ability to participate in society. Homr & Budd (1985) used Total Communication and physical prompts to teach functional signs to an 11-year-old boy with autism as an intervention for yelling and grabbing during specific classroom transition periods. The training sessions began in an isolated corner of the classroom in which the trainer presented spoken phrases and materials associated with the initiation of disruptive behavior. When the child did not demonstrate spontaneous generalization of sign use to the actual situations, he was trained in the natural environment. His disruptive behavior dropped to nearly zero and his use of sign requesting in the stimulus conditions increased to 100% within three sessions of training in the classroom environment. This finding illustrates the importance of teaching in the natural environment and training other adults who are present during the child’s regular day.
Natural language teaching is more often used when the reduction of disruptive behavior is under study. There is some evidence that improving signed or spoken language skills in children with autism can reduce disruptive behaviors such as aggression, tantrums, self-injurious behaviors, yelling, and physical and vocal stereotypy (Goldstein, 2002). Koegel, Koegel, and Surratt (1992) investigated the effect of natural language teaching with three autistic preschoolers identified as having severely disruptive behaviors. They found that the total percentage of time the children were disruptive decreased from as high as 65 percent with structured teaching methods to between 4 and 8 percent with natural teaching methods. Further, all three of the children attempted and spoke more words in the natural than in the structured teaching setting. Mothers taught to use Total Communication were able to decrease their autistic children's inappropriate behaviors without specifically directing the intervention towards the behaviors. (Casey, 1978). Webster, McPherson, Sloman, Evans, and Kuchar (1973) noted decreased bizarre behaviors and tantrums after a child whom they were working with began understanding receptive instructions and using gestural forms of expressive communication.

Behavior problems relevant to this study include vocal stereotypy, hand flapping, mouthing, and tantrumming. Each will be discussed specifically below.

Stereotypy

Stereotypy, commonly defined as repetitive and nonfunctional motor behavior, has been found to occur in 99.5 percent of children with autism (Campbell et al., 1990). Through functional analyses in single case studies these behaviors have been found to serve multiple functions, including sensory stimulation and automatic reinforcement,
(e.g., Kennedy, Meyer, Knowles, & Shukla, 2000; Rapp, 2006; Taylor, Hoch, & Weissman, 2005), attention-seeking (e.g., Kennedy, Meyer, Knowles, & Shukla, 2000), escape or avoidance (e.g., Asmus, Franzese, Conroy, & Dozier, 2003; Kennedy, Meyer, Knowles, & Shukla, 2000), obtainment of desired tangible items, (e.g., Asmus, Franzese, Comoy, & Dozier, 2003; Kennedy, Meyer, Knowles, & Shukla, 2000), or as self-amusement because of a lack of functional play skills (e.g., Nuzzolo-Gomez, Leonard, Ortiz, Rivera, & Greer, 2002). On the surface, stereotypy may appear harmless; however, it has been found to interfere with learning, compete with the acquisition of adaptive and academic skills, and can be socially stigmatizing (Chock & Glahn, 1983; Koegel & Covert, 1972; Luiselli, Ricciardi, Zubow, & Laster, 2004; Runco, Charlop, & Schreibman, 1986).

**Causes of stereotypy.** The causes of stereotyped behavior in autism remain unclear. Many of the behaviors, such as body rocking, head rolling, and hand flapping are present in all infants and toddlers (Symons, Sperry, Dropik, & Bodfish, 2005). It has been hypothesized that neurobiological mechanisms involving dopamine and the striatum are involved in the continuance of stereotypy beyond early childhood in children with autism (Lewis & Bodfish, 1998). Turner (1999) hypothesized that an inability to spontaneously generate new behaviors results in the repetitive behaviors commonly seen in autism. She referenced the finding that the highest rates of stereotypy occur when autistic children are alone and hypothesized that this is due to difficulty generating ways to fill their time. Consistent with Turner’s hypothesis, Clark and Rutter (1981) found that loosened structure at the time of task completion was significantly correlated with increased stereotypy.
Punishment of stereotypy. There is still debate about what is the most effective method for the reduction and the maintenance of reduced stereotypy. Studies show that punishment procedures or other direct treatments have not proven effective in decreasing stereotypical behavior in children with autism. In fact, some studies have shown that compared with teaching specific alternatives to stereotypy, the use of punishment or differential reinforcement of non-stereotypy may actually increase occurrence. In a study involving three 5- to 7-year-old boys with autism, Harris & Wolchik (1979) demonstrated unchanged and even increased stereotypy following both differential reinforcement of other (non-stereotyped) behavior and time-out procedures as punishment for stereotypy. One of the children responded aggressively to time-out procedures. Although punishment has successfully decreased stereotypy in some cases, maintenance of the reduction is limited. Once the punishment procedures were removed, the behavior tended to resurface. Harris and Wolchik (1979) demonstrated this pattern following the removal of time-out and overcorrection contingencies for stereotypy. Within days, each child's rate of stereotypy had increased, at times returning to baseline levels. The authors hypothesized that new replacement behaviors were not competitive enough with the automatic reinforcement obtained from stereotypy.

Role of communication training in reducing stereotypy. As described above, Horner & Budd (1985) noted reduced maladaptive behavior after teaching sign targets in the natural setting to a child with autism. They taught five Amslan signs that allowed the child to state his preferences and increase control over his environment. His disruptive behavior dropped to nearly zero within three sessions of training in the natural environment. Casey (1978) demonstrated decreased disruptive classroom and home
behavior in four children with autism following parental use of Total Communication during parent-child interactions. The behaviors that were observed to decrease included both stereotypy and tantrums. Teachers reported that the children were more engaged, less withdrawn, and were more flexible when confronted with unexpected environmental and schedule changes.

**Role of engagement in reducing stereotypy.** As stated above, increased stereotypy is often associated with loose structure or solitude. The research indicates that reduced rates of stereotypy may be associated with on-task behavior and interpersonal interaction. Nuzzolo-Gomez, Leonard, Ortiz, Rivera, and Greer (2002) showed that teaching children aged 3 to 7 years old with autism how to engage with books or other toys resulted in a reduction of stereotypy. Children in the study were chosen for their high frequency of stereotyped behavior. Out of sixty 5-minute intervals, the mean baseline number of intervals containing stereotypy for each of the three children studied were 32.6, 13.4, and 41.1. Following play instruction and reinforcement, the mean number of intervals containing stereotypy decreased to 6.7, 6.8, and 12.7 respectively. Without using direct punishment or other treatments for stereotypy, the children’s frequency of stereotyped behavior was still reduced to over half of their previous level in each case.

There is also research support for an association between interpersonal interaction and reduced stereotypy. Runco, Charlop, and Schreibman (1986) found that autistic children engaged in stereotyped behavior significantly less often when working with a known therapist and exhibited significantly more stereotypy when working with an unknown therapist or when alone in a free play setting. Dadds, Schwarts, Adams, and Rose (1988) also found a correlation between interpersonal contact and lowered rates of
stereotypy. They reported that individual attention was correlated with reduced stereotypy for both high- and low-verbal children with autism. Autistic children with low verbal ability in particular evidenced a significant increase in stereotypy when left alone or in free play settings.

Clark and Rutter (1981) found that boys with autism demonstrated reduced stereotypical behaviors around adults who asked questions and imposed physical and verbal contact compared to non-intrusive adults. Ten boys with autism were paired with an adult who placed either high or low interpersonal demands on them during both structured and unstructured activities. In opposition to their hypothesis that the children would try to avoid the adults demanding high interpersonal interaction, Clark and Rutter found that the boys engaged in more on-task behavior, were more socially responsive, and spoke more when high interpersonal demands were imposed.

It cannot be assumed, however, that reduced stereotypy will lead to increased engagement or attention. A 6-year-old boy with autism was able to contain his handflapping during class instruction with the implementation of visual cue cards and a verbal explanation of expectations (Conroy, Asmus, Sellers, & Ladwig, 2005); however, reduced hand flapping did not increase his engagement with class activities. The authors concluded that it is better to teach a child when it is inappropriate to engage in stereotypy rather than to attempt to eliminate it altogether.

Mouthing

Mouthing is a potentially dangerous problem that can lead to choking or ingestion of poisonous substances. Further, it promotes the spread of germs and can be stigmatizing. Mouthing is believed to be automatically reinforcing. It is one of the
behaviors that has been found to discriminate between typical and developmentally delayed 9- to 12-month-old infants and those later diagnosed with autism (Baranek, 1999). Efforts to reduce mouthing in children with autism have been both challenging and time consuming. Carr, Dozier, Patel, Adams, and Martin (2002) applied a combination of physically blocking every mouthing attempt and a fixed-time delivery of noncontingent reinforcement with a 7-year-old girl who mouthed 20 to 100 percent of the time during baseline measurements. The authors were successful at reducing her mouthing from 40 times in a 10-minute period to as low as zero attempts during an entire 10-minute period. The authors were then able to decrease the time-consuming demands of the intervention without a reduction in effectiveness by blocking the child’s mouthing attempts every other time and delivering noncontingent reinforcement every 5 minutes.

Consistent with the research on stereotypy, punishment of mouthing has also been associated with increased disruptive behaviors. In one child, the treatment of mouthing by overcorrection was correlated with increased aggressiveness (Wells, Forehand, and Hickey, 1977). Verbal warnings and overcorrection procedures were found to decrease mouthing in two 10-year-old boys with autism and mental retardation from means of 65 percent and 58 percent of the time to means of 5 percent to 34 percent of the time, respectively. The overcorrection procedures, which included a verbal warning followed by 2 ½ minutes of manually guided appropriate play, were found to have little effect on the generalization of appropriate play for both children, however. For one of the children, overcorrection was also associated with increased episodes of aggression and escape behavior, occurring 22 percent of the time on average during sessions. It was also noted that the children’s mouthing increased to near baseline levels when the therapist turned
his back to the children, indicating that the procedure is both time consuming and requires constant vigilant attention to ensure maintenance.

Tantrumming

Although often considered maladaptive, tantrumming for a child with little language may be one of the few available and effective means of communication. Schuler, Prizant, and Wetherby (1987) noted that tantrums and other apparently dysfunctional behaviors may be the autistic child’s only way of predictably controlling his or her environment and either protesting unpleasant events or advocating for desired events. Language learning has been found to be an adaptive alternative to communication that may otherwise be only achieved through tantrumming. A child who is able to spontaneously generate language can better control his or her environment through more appropriate means.

Few studies have investigated the use of language to decrease tantrums in children with autism. Two children in Casey’s (1978) study demonstrated tantrums that decreased to nearly zero after their mothers were trained in Total Communication.

Rationale/Theoretical Background

Because of the vast differences between different autistic children’s capabilities, single-case design research is necessary for the study of many issues. Further, naturalistic, as opposed to didactic, methods may be more individualized to the child based on what is important to him or her. Unfortunately, there is a dearth of treatment manuals emphasizing naturalistic teaching methods available to parents and paraprofessionals (Rogers, 2006). The alternative, bringing a trained professional into the home to facilitate naturalistic language teaching, can be costly.
The method that will be used in this study is based on Schaeffer, Raphael, and Kollinzas's (1994) manual, *Signed Speech for Nonverbal Students*. The manual emphasizes initial independent instruction in verbal imitation and sign. Verbal imitation consists of teaching the child to articulate the necessary sounds to produce words, and sign instruction consists of using physical molding of the child's hands to teach signs as opposed to modeling and imitation. This method of teaching prevents dependence upon modeling prompts, a problem that can prolong language acquisition, be time-consuming to correct, and inhibit the spontaneous generation of language (Tincani, 2004).

**Purpose of the Study**

There are still many unresolved issues concerning which method of language instruction is the most effective and efficient for children with autism. Some studies have found that combining methods yields results superior to adopting one single method, whereas others find no difference or superiority with sign-alone training. Aside from the method used, other contributors to discrepancies in results appear to be related to the skills with which the child entered the instruction program, whether the language taught was receptive or expressive, whether full phrases or single words were taught, whether the child possessed high or low verbal imitation skills, and whether the words taught had functional or intentional meaning to the child. Also relevant to the results were the overall purposes of the studies. Dependent variables in studies range from receptive identification of common items to spontaneous verbal requests or comments.

Because each child with autism is unique, single case study is used to broaden the repertoire of therapists working with this population. Although only one child may benefit directly from the study, dissemination of the methods by which the results were
obtained may help other professionals alter their programs in ways that are effective and efficient for children with autism and the people who work with them.

Several hypotheses will be examined in the present study:

Hypothesis 1: The rate of acquisition of language (signed and/or spoken) to make requests will be different for requests taught by Total Communication, as in the Signed Speech program, and from requests taught verbally, as in the Verbal Behavior program.

Hypothesis 2: Stereotypy will decrease as language (signed and/or spoken) increases.

Hypothesis 3: Vocal stereotypy and mouthing will decrease as language (signed and/or spoken) increases.

Hypothesis 4: Tantrums will decrease in frequency as language (signed and/or spoken) increases.

Method

Participant and setting

The participant was a 4-year-old Caucasian boy diagnosed with autism by a neurodevelopmental pediatrician. He was living in a suburban community in an intact family. He is an only child. Both parents were working full time. During weekdays, a caregiver experienced with autism provided in-home supervision for the child and transitioned him to school. At the time of the study the boy was enrolled in Early Childhood Special Education through his public school district. Services provided by his school district consisted of 12 hours of instruction using Pivotal Response Training, the Picture Exchange Communication System (PECS; Bondy & Frost, 1994), and sensory play. He was also receiving approximately 1 hour of speech intervention per week through the school district, primarily focused on Picture Exchange training. This child
was selected for the study because of his lack of functional speech and his potential to benefit from intensive sign instruction; at the time of recruitment the boy did not discriminate accurately between either signs or pictures. His parents reported that he primarily used one sign, pointing to his mouth (an approximation to the sign 'eat') as his way of requesting anything and everything. Further the child demonstrated severe behavior problems. He had been expelled from two daycare settings, which is what had necessitated the use of an in-home caregiver. During the time of the study he went through two caregivers and was threatened with expulsion from a Christmas camp.

The setting for the study was the child’s home. The child was also brought to the dissertation advisor’s office approximately every other week for assessment, reliability checks, and instructional and behavioral troubleshooting.

**Design**

The study used a multi-element design consisting of a baseline phase followed by alternation between two conditions and a final “best-treatment” phase (Heward, 1987). The two conditions compared were Total Communication Request Training (TCRT) and Word Request Training (WRT). The purpose of alternating between the two training conditions was to compare the acquisition rate during TCRT with that during WRT.

**Procedure**

**Phase I: Baseline Assessments**

Baseline assessments consisted of both specific and broad-based ideographic and nomothetic measures of several behaviors. The Autism Screening Instrument for Educational Planning –Second Edition (ASIEP-2; Krug, Arick, & Almond, 1993) and Assessment of Basic Language and Learning Skills (ABLLS; Sundberg & Partington,
broad-based nomothetic measures, were used to obtain an overall baseline characterization of the child’s autistic characteristics and communication skills.

Preference assessment. The study’s ideographic measures are described in more detail below. A list of six preferred items or activities for which to teach sign or word requests was created, based on caregiver report and the child’s responses to a stimulus preference assessment (Carr, Dozier, Patel, Adams, & Martin, 2002). Because the child had a large variety of potentially reinforcing foods, a stimulus preference assessment consisting of two potentially reinforcing items presented in a forced-choice format, was conducted to rank order his preference for food items. Preferred items were placed into two groups of comparable desirability and, as far as possible, comparable overall approximate difficulty of fine motor movement for signs and articulation/pronunciation for words. It was unknown in the beginning how quickly the child would be able to acquire the language (in either sign and/or word) for the chosen targets. Four initial targets were chosen, along with two tentative additional targets, only to be added if time remained in the study. As the study progressed, the child’s fine motor discrimination guided part of the decision-making process regarding which additional sign and word targets would be least confusing for the child. Signs to request three desired foods/activities were taught during TCRT; words to request three different desired foods/activities were taught during WRT. The child’s access to target foods/activities was limited during treatment sessions, to decrease satiation within sessions and make sure that he had equal exposure to each target.

Requesting assessment. A baseline assessment of requesting was conducted to ensure that the child did not already have the ability to request the targets through signed
or verbal communication. The target foods/activities were presented randomly. The food/activity was made available to the child and as he approached, he was asked, “What do you want?” in Total Communication (TC) for 3 trials and verbally alone for 3 trials. Use of TC or verbal communication was randomized over trials.

Frequency and mode of requesting were recorded during baseline assessments. Each time the child made a request, the occurrence, mode of requesting (sign, gesture, hand-leading, words, etc.), accuracy of the mode (using descriptive terms or exact sounds), and whether or not the request was spontaneous were recorded. Requesting was also assessed at baseline using the Assessment of Basic Language and Learning Skills (ABLLS; Sundberg & Partington, 1998).

Fine motor assessment. Fine motor assessment was conducted using the Fine Motor subtest of the ABLLS. The purpose of this measurement was to identify the child’s motor limitations and obtain a baseline measure of his fine motor skills, which could impact his ability to independently form signs. Signs that required modification during the study (due to either fine motor difficulties or for the purpose of increasing discriminability between similarly formed signs) were modified after team consultation.

Speech sounds assessment. A speech sounds assessment was conducted using ideographic frequency counts over three successive weekdays, the Sample of Vocal Behavior subtest of the ASIEP-2, and the ABLLS. Idiographic data collection consisted of writing down all of the child’s speech sound utterances throughout the day; a frequency percentage was determined based on 2-minute partial intervals over the course of 1 hour. Because the child’s speech sound skills constituted one of the dependent variables in the study, it was important that a baseline measure of speech sound
production be obtained prior to implementing the treatment conditions. The Sample of Vocal Behavior subtest of the ASIEP-2 consists of a verbatim recording of the child’s first 50 spontaneous utterances. The utterances are then categorized based on variety, function, articulation, and length. The Educational Assessment subtest of the ASIEP-2 includes screens for receptive and expressive language and speech imitation.

Assessment of inappropriate or nonadaptive behaviors. Behavior problems were also assessed at baseline using ideographic measures. Hand flapping, vocal stereotypy, and mouthing of edible or inedible objects were recorded using 2-minute partial interval counts over a period of 1 hour, which were then expressed as a percentage, over three successive weekdays. Tantrum frequency over the course of the days was also recorded and specific behaviors comprising each tantrum were labeled and noted. The Autism Behavior Checklist subtest of the ASIEP-2 was also administered to assess nonadaptive autistic behaviors in the child.

Phase II: Language Training

Following determination of a baseline level of requests for target foods/activities, signs, speech sounds, and inappropriate or maladaptive behaviors, the two treatments, TCRT and WRT, were introduced. Control was maintained across training conditions by presenting each training method for the same number of trials or requests per day. At times this was not possible due to unforeseen circumstances (e.g., time limitations, variable child motivation) and so trials were evened out the following day. Approximately comparable time dedicated to each instructional modality was initially attempted but this was abandoned due to differing lengths of time required to carry out a single request or trial with a sign and a word and varied rates of acquisition and interest
on different training days. The importance of intrinsic motivation was upheld during the study, with the result that the child did not request a particular target with equal frequency across sessions. When this occurred, consistency in the number of trials between the current targets was maintained by limiting requesting opportunities for the more desired targets until equal numbers of requests for all targets were achieved. For example, if the child desired Drink but was behind on Swing, he might only need to request Drink once, at the beginning of the session, in order to have access to the Drink for an hour. Presentation of the targets was initially counterbalanced so that the same modality was not used to teach two targets in a row. As the boy’s fluency of requesting increased and independent requesting occurred more frequently, the boy demonstrated a natural progression into discrimination and often correctly requested two different items in close proximity. Discrimination trials were systematically introduced only on occasions in which the boy was unable to maintain mastery-level discriminated performance on his own. The mastery criterion for a target consisted of 80 percent correct spontaneous (unprompted) responses within a 2-hour period in which at least 20 trials had occurred. Examples of spontaneous unprompted trials include requests initiated by the child or the child’s correct response to an inquiry such as “what do you want?” The item or activity may or may not have been visible to him during the requesting.

*Total Communication Request Training (TCRT).* The procedures for TCRT were based on the Signed Speech Program (SSP; Schaeffer, Raphael, & Kollinzas, 1994). This method involves following the child’s motivation. It relies upon the use of Total Communication (simultaneous signs and words in communications with the child), uses sign molding and physical prompts to teach signs, and minimizes the use of modeling
(imitative) prompts. Training trials were conducted until the child satiated on the assigned targets or until the number of trials equaled the total number of trials for other targets.

**Word request training (WRT).** The procedures for WRT were based on the principles of Verbal Behavior (VB; Sundberg & Michael, 2001). Like SSP, this method also involved following the child's motivation, but it used an echoic prompt to teach the verbal target. Training trials were conducted until the child satiated on the assigned targets, or until a number of trials comparable to those for other targets was presented. Two verbal word request target items were introduced initially; the third target was introduced after mastery of one of the initial two. The first two targets introduced were *Orange* and *Swing*; *Peanut* was introduced after the child reached the mastery criterion on *Orange*.

The WRT targets were complicated for two reasons. First, because the child had minimal verbal imitation skill, it was very difficult for him to learn the word request targets. The criterion was therefore lowered and partial verbal requests were permitted. *Orange* and *Swing* (and later *Peanut*) approximations were counted as partial verbal independent requests and coded as such. The exact sounds that were produced correctly by the child and scored as correct are listed in Table 1.

When necessary, physical prompts to the child’s mouth were used to help him form the correct sounds. For *Orange*, the instructors sometimes cupped the child’s mouth into an “oh” shape. For *Swing*, the instructors pulled the child’s lips to the sides to form an “ee” shape. For *Peanut*, the instructors placed the peanut to the child’s lips to elicit a
Table 1

Acceptable sound approximations for verbal targets.

Peanut: any consonant or consonant-vowel combination starting with /p/; buh; /bð/; (but not boh, baa, buhbuh, boo, or bie)

Orange: any vowel or vowel-consonant combination starting with /oh/; uh; ah; guh; go; oo

Swing: any vowel or vowel combination containing /w/; oo; ee; dee; vay; aye; eeg;

“puh” sound. During the biweekly meetings, the faculty advisor was involved in experimentation on prompting, in order to develop prompting strategies that worked for the child. The strategies were then continued during daily training sessions until the child was able to form the correct oral-motor movement without prompting.

Phase III: Best Treatment

The best treatment phase was introduced after the child met the mastery criterion of 80 percent for all three targets assigned to one specific treatment method, identifying that method as the “best” treatment method. In this case, the TCRT method was identified as the best treatment method and systematically applied to each target initially introduced via the WRT treatment method. Ideally, all three words would have been taught in the best treatment method, but due to time constraints there was only time for one target to be mastered in both teaching methods, TCRT and WRT, and two targets to be exposed to both. In this way the initial method acted as a second baseline for the best treatment method.
Dependent Variables and Data Collection

There were nine dependent variables in the study: (a) single signs produced spontaneously, (b) single sign-word/approximation combinations produced (Signed Speech) spontaneously, (c) single words or word approximations spontaneously verbalized (unsigned), (d) mouthing of edible or inedible items (e) vocal stereotypy, and (f) tantrumming. The initial proposed method contained many more dependent variables that over the course of the study proved not to be relevant. Spontaneous sign phrases (two or more signs), spontaneous word phrases (two or more words) in unsigned speech, and hand flapping were initially identified as dependent variables but were either not encountered during the study (spontaneous phrases) or rarely occurred (hand flapping). The six recorded dependent variables were measured at baseline and throughout the study, to the end of formal TCRT and WRT training. The dependent variables were recorded throughout each session by event recording (variables a, b, c, and f) or in 2-minute partial intervals over the course of an hour (variables d and e). The reason for the use of partial intervals is that the duration for the behaviors being measured varied within and between sessions.

Treatment of data

Interobserver agreement and procedural integrity. Interobserver agreement was obtained through simultaneous collection of communication and behavior data by the investigator or the child’s tutor for approximately 20 percent of all sessions. Biweekly working meetings with the faculty advisor also contributed to establishing reliable data collection and procedural integrity.
Data analysis

Data for the communication variables were divided into five types: spontaneous, independent, prompted, shaped, and incorrect requests. Spontaneous requests were requests for an item occurring outside of the specific instruction period for that item. An example of this would be the child’s requesting *Drink* during lunch. Independent requests occurred within the specific instruction period for that item and did not require shaping or prompting by the therapist. Data was compiled in the form of a daily percentage, by dividing the number of independent requests by the total number of daily requests or trials. Percentages for prompted, shaped, and incorrect responses were compiled using the same method. The child produced prompted requests most frequently during the initial learning phases of instruction. Physical or verbal prompts were required in order to help him initiate a correct request. Prompts were provided by the therapist and were initiated prior to allowing an independent response by the child. This is in contrasted to shaped responses, in which the child attempted to request the item independently but required assistance from the therapist in order to correctly execute the request. If five shaped responses were required for a particular request item, the therapist then initiated prompted responses until the child was able to produce the request independently. Incorrect responses were those that were completely wrong; an example would be reaching for the swing while signing “*Berry*. ” A percentage for each type of request was computed by taking the number of that type of request and dividing by the total number of requests. Also, sign and word requests were closely monitoring and recorded, for the documentation of sign and word form and of spontaneous generalization, or over-generalization, of sign and/or word use. As the child developed the ability to discriminate
and request items serially, records of spontaneous requests were no longer maintained. Initially spontaneous requests were recorded outside of study sessions by parents and caregivers but adherence fell short and so this data was not used in the analysis for the current study.

Data was also compiled to obtain the daily frequency percentages for mouthing and vocal stereotypy. Hand flapping data was not recorded beyond baseline due to the low frequency of occurrence during baseline.

Tantrums were recorded during the study sessions. Although the parents and school were initially also asked to record tantrum data, the data were unreliable due to weak adherence to recording procedures. Thus, the only tantrum data included in this study were those recorded during the study sessions. Total number of tantrums thrown each week were averaged based on the total number of hours the child spent participating in the study that week. An average was obtained by tallying the number of tantrums during the week and dividing the total by the total number of hours that week the child participated in the study.

Results

Baseline Assessment

Preference Assessment

The results of the preference assessment yielded several preferred items, determined via the forced choice format. Items were chosen for the study based on the results of the preference assessment and the likelihood of variety available within and between items in order to prevent satiation. Different items were not presented an equal number of times during the preference assessment. If the child did not prefer an item
during the forced choice format, the lesser-preferred item was not repeatedly presented; rather, the more preferred item was paired with other preferred items in order to determine a ranking of preference amongst the most preferred items. Table 2 lists the items included in the preference assessment and the number of times those items were chosen by the child. *Swing, Music, Trampoline, Walk, Oranges,* and *Outside* were found to be the most preferred items. Following discussion with caretakers and consideration of the likelihood that the targets would remain preferred during unpleasant weather, the outdoor targets (*Outside* and *Walk*) were rejected. One of the child’s caregivers, uninvolved in the study, used music heavily as a therapeutic tool and so music was also rejected as a target. The parents and caregivers indicated that the child’s trampoline was not always a preferred item and the child satiated easily on it, so this target was rejected as well, in favor of adopting a target that would be reinforcing to him on a consistent, daily basis.

Based on the results, consultation with parents and caretakers, and consideration of feasibility and satiation factors, four initial targets were chosen: *Drink, Orange, Swing,* and *Berry*. Although preference for berries and drinks were not evaluated in detail during the preference assessment, these items were chosen based on high consumption by the child when he was given access to berries and the interesting (to him) variability of berries and drinks available. The child also had a strong preference for mandarin oranges and a variety of indoor swings. The final two targets to be added were *Chip* and *Peanut*; despite the fact that he did not choose peanuts in the forced choice format, the child very much enjoyed eating peanuts.
Requesting Assessment

Requesting skills were assessed with the ABLLS. The child showed the ability to request at least three different items or activities several times per day. He was able to request “eat,” “open,” and “all done” in sign, whether presented with the item, the question “what do you want?,” or spontaneously. His sign for “eat” was simplified, consisting of pointing to his mouth (rather than pinching all of his fingers together towards his mouth). He also indicated “yes” by nodding. He demonstrated the use of above signs and gestures during the requesting assessment, including signing “eat” when requesting a drink.

Speech Sounds Assessment

Sound combinations were broken into their individual sounds. Over the 3 days, the child vocalized a total of 11 consonant sounds (b, d, g, h, k, l, m, n, p, w, y), all 5 long vowel sounds, and 4 short vowel sounds (a, e, o, u). Over the 3 days, the child vocalized a total of 33 sounds and/or sound combinations. Two-minute partial interval data was taken over the 3-day baseline period to track the child’s frequency of vocalizing speech sounds. The child vocalized 67 percent of the time on Day 1, 47 percent of the time on Day 2, and 67 percent of the time on Day 3. Table 3 lists the sounds vocalized during the baseline period.

On the Sample of Vocal Behavior subtest of the ASIEP-2, the child’s score was in the 56th to 57th percentile for children his age with autism. Table 4 lists the subtest scores. His (verbal expressive) language age equivalent was estimated at 16 months. The child uttered 27 unique sounds during the recording period, the remainder of the utterances being repetitions of those sounds. None of the utterances appeared to have a clear
Table 2

Preference Assessment

<table>
<thead>
<tr>
<th>Item</th>
<th>Times Preferred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raisins</td>
<td>0</td>
</tr>
<tr>
<td>Cereal</td>
<td>1</td>
</tr>
<tr>
<td>Swing</td>
<td>16</td>
</tr>
<tr>
<td>Peanut</td>
<td>0</td>
</tr>
<tr>
<td>Walk</td>
<td>3</td>
</tr>
<tr>
<td>Candy</td>
<td>7</td>
</tr>
<tr>
<td>Music/music toys</td>
<td>9</td>
</tr>
<tr>
<td>Scarves</td>
<td>1</td>
</tr>
<tr>
<td>Crackers</td>
<td>0</td>
</tr>
<tr>
<td>Cookies</td>
<td>0</td>
</tr>
<tr>
<td>Oranges</td>
<td>8</td>
</tr>
<tr>
<td>Bubbles</td>
<td>1</td>
</tr>
<tr>
<td>Pickles</td>
<td>0</td>
</tr>
<tr>
<td>Trampoline</td>
<td>3</td>
</tr>
<tr>
<td>Outside</td>
<td>3</td>
</tr>
<tr>
<td>Blues Clues toys/videos</td>
<td>2</td>
</tr>
<tr>
<td>Drink</td>
<td>2</td>
</tr>
</tbody>
</table>
function. Articulation was not measurable because the child spoke no words. His utterances were monosyllabic.

Table 3

*Baseline Speech Sounds*

<table>
<thead>
<tr>
<th>Consonants</th>
<th>/b/, /d/, /g/, /h/, /j/, /l/, /m/, /n/, /p/, /w/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vowels</td>
<td></td>
</tr>
<tr>
<td>Long</td>
<td>a, e, i, o, u</td>
</tr>
<tr>
<td>Short</td>
<td>aa, eh, ah, uh, oo, ow</td>
</tr>
</tbody>
</table>

Table 4

*Baseline ASIEP-2 Sample of Vocal Behavior*

<table>
<thead>
<tr>
<th>Domain</th>
<th>Raw score</th>
<th>Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetitive</td>
<td>24 (27.3)</td>
<td>--</td>
</tr>
<tr>
<td>Noncommunicative</td>
<td>50 (36.9)</td>
<td>--</td>
</tr>
<tr>
<td>Babbling</td>
<td>35 (32.0)</td>
<td>--</td>
</tr>
<tr>
<td>Unintelligible</td>
<td>50 (35.0)</td>
<td>--</td>
</tr>
<tr>
<td>Total</td>
<td>159 (134)</td>
<td>56</td>
</tr>
</tbody>
</table>

Note: ASIEP-2 = Autism Screening Instrument for Educational Planning, Second edition. Scores in parentheses indicate starting points for typical autistic scores. Higher scores indicate stronger autism characteristics.
On the Educational Assessment subtest of the ASIEP-2, the child’s score was in the 67th to 68th percentile, indicating that his performance was similar to that measured in children with autism. Table 5 lists the subtest scores. His scores are consistent with his placement in an Early Childhood Special Education setting. The child demonstrated adequate abilities to stay seated but had difficulty with body concepts and speech imitation, compared with autistic peers.

Table 5

*Baseline ASIEP-2 Educational Assessment*

<table>
<thead>
<tr>
<th>Domain</th>
<th>Raw score</th>
<th>Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>In seat</td>
<td>12 (12.0)</td>
<td>--</td>
</tr>
<tr>
<td>Receptive language</td>
<td>5 (6.6)</td>
<td>14</td>
</tr>
<tr>
<td>Expressive language</td>
<td>2 (4.0)</td>
<td>26</td>
</tr>
<tr>
<td>Body concept</td>
<td>4 (6.5)</td>
<td>13</td>
</tr>
<tr>
<td>Speech imitation</td>
<td>2 (5.7)</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>68</td>
</tr>
</tbody>
</table>

Note: ASIEP-2=Autism Screening Instrument for Educational Planning, Second edition. Scores in parentheses indicate starting points for typical autistic scores. Higher scores indicate stronger autism characteristics.

*Receptive Language Skills*

Receptive language skills were assessed using the ABLLS. The child required prompting to correctly respond to instruction or identify object labels. He was able to
independently follow instructions to select (i.e., give me, point, etc.). The child was able to follow instruction to “go to” up to 4 persons identified by name. He was able to receptively identify 3 body parts on himself and 1 body part on another, and 4 items of clothing. He was able to identify six 2D object labels and at least ten 3D object labels. He was able to identify the known objects in an array of 2 choices, but he was only able to identify 4 to 5 3D object labels and 7 to 8 2D object labels when presented in an array of 3. He was not able to identify known objects from an array greater than 3.

Only with prompting was the child reliably able to respond to his own name, follow instructions to do at least 3 enjoyable actions either within or without context, and at least three instructions in routine situations. He was only able to follow instructions to look at a reinforcing item if the item was held in front of him; he was not able to follow instructions to look at a common item under any condition.

The child was not able to perform any receptive actions with or without an object (clap, sit, cut, etc.). He was not able to receptively identify adjectives, functions, classes of objects, prepositions, pronouns, emotions, and associations. He was not able to go to a specified person and retrieve a specified item or perform a specific action.

Vocal Imitation Skills

The child demonstrated no vocal imitation skills on the ABLLS, earning zero credit.

Labeling Skills

The child received zero credit on this subscale of the ABLLS. He was not able to expressively label any items.
Spontaneous Vocalizations

The child did not demonstrate meaningful spontaneous vocalizations on the ABLLS. He was observed babbling frequently, at least 10 minutes per hour. His mother reported that the child occasionally, two to three times per week, spontaneously vocalized a word that might or might not be contextually appropriate.

Fine Motor Assessment

The ABLLS was used to assess fine motor skills. The child demonstrated rudimentary fine motor skills. He was able to appropriately place pegs in holes, rings on pegs, and do simple single-piece insert puzzles. He was able to stack blocks, turn lids, open Ziplock bags, snip with scissors, use a pincer grip, hold a crayon, turn book pages, and squeeze glue from a bottle. He did not have fine motor imitation skills, however.

Assessment of Inappropriate or Nonadaptive Behaviors

On the Autism Behavior Checklist of the ASIEP-2, the child’s total raw score was 79. Scores of 77 or higher are considered typical of children with autism, with higher scores indicating more strongly autistic behavior. Table 6 lists the subtests and the child’s scores on the Autism Behavior Checklist.

Frequency counts for motor and vocal stereotypy and mouthing were also done at baseline, using 2-minute partial interval data. Table 7 lists the results. Motor stereotypy ranged from 0 to 10 percent of the time over the 3-day baseline period. Vocal stereotypy ranged from 73 to 83 percent and mouthing from 63 to 83 percent. As stated above, motor stereotypy was not tracked during the study due to its low frequency at baseline.
Table 6

Baseline ASIEP-2 Autism Behavior Checklist

<table>
<thead>
<tr>
<th>Domain</th>
<th>Raw scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory</td>
<td>6 (13)</td>
</tr>
<tr>
<td>Relating</td>
<td>14 (24)</td>
</tr>
<tr>
<td>Body and object</td>
<td>22 (16)</td>
</tr>
<tr>
<td>Language</td>
<td>21 (12)</td>
</tr>
<tr>
<td>Social and self-help</td>
<td>16 (13)</td>
</tr>
<tr>
<td>Total</td>
<td>79 (77)</td>
</tr>
</tbody>
</table>

Note: ASIEP-2=Autism Screening Instrument for Educational Planning, Second edition. Scores in parentheses indicate starting points for typical autistic scores. Higher scores indicate stronger autism characteristics.

Table 7

Baseline Percentage of Stereotypy and Mouthing

<table>
<thead>
<tr>
<th>Stereotypy</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor</td>
<td>0</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Vocal</td>
<td>80</td>
<td>73</td>
<td>83</td>
</tr>
<tr>
<td>Mouthing</td>
<td>70</td>
<td>83</td>
<td>63</td>
</tr>
</tbody>
</table>
Results for Hypothesis 1

We predicted that language acquisition would differ based on method of instruction. Targets were systematically introduced in either total communication (TCRT) or verbal-only (WRT) instruction. The three targets chosen for TCRT were Drink, Berry, and Chip. The three words chosen for WRT were Swing, Orange, and Peanut. Drink, Berry, Orange, and Swing were introduced at the same time. Chip was introduced after Drink was mastered. Peanut was introduced after Orange was mastered. Table 8 lists the number of request instructional trials required for mastery of each of the six targets.

The child was able to achieve mastery criterion for all three of the TCRT targets. It took the child 387 instructional requests to master Drink and 734 to master berry. He mastered Chip after 1,505 requests. The child did not produce Signed Speech for any target items, although he paired the sign with a phoneme associated with the target word. Figures 1 through 3 graph the use of signs and Signed Speech by the child for targets taught via TCRT.

 Whereas all three targets that were taught via TCRT were mastered to criterion by the child, only Orange met criterion in the WRT training, and only unreliably. It took hundreds of sessions for the child to even learn that he was expected to produce an utterance as a means of obtaining the desired item. Neither Swing nor Peanut met criterion in WRT, or even achieved reliable and consistent verbal approximation with either physical or verbal prompting.
<table>
<thead>
<tr>
<th>TCRT targets*</th>
<th>Request Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drink</td>
<td>387</td>
</tr>
<tr>
<td>Berry</td>
<td>734</td>
</tr>
<tr>
<td>Chip</td>
<td>1505</td>
</tr>
<tr>
<td>(Swing)</td>
<td>349</td>
</tr>
<tr>
<td>(Orange)</td>
<td>discontinued at 542</td>
</tr>
<tr>
<td>(Peanut)</td>
<td>not introduced</td>
</tr>
<tr>
<td>WRT targets**</td>
<td></td>
</tr>
<tr>
<td>Swing</td>
<td>transferred to TCRT after 3157 trials</td>
</tr>
<tr>
<td>Orange</td>
<td>1178</td>
</tr>
<tr>
<td>Peanut</td>
<td>transferred to TCRT after 1800 trials</td>
</tr>
</tbody>
</table>

Note: TCRT=Total Communication Request Training; WRT=Word Request Training. Mastery criteria defined as 80% independently produced. Targets in parentheses were introduced into both TCRT and WRT. *Sign and/or word approximations count as independent. **Word approximation counts as independent.
Figure 1. Results of Hypothesis 1 for Total Communication Request Training (TCRT) target Drink. Start date was October 5. Number of independent sign and Signed Speech (SS) requests per every 50 requests made.

Figure 2. Results of Hypothesis 1 for Total Communication Request Training (TCRT) target Berry. Start date was October 5. Number of independent sign and Signed Speech requests per every 50 requests made.
Figure 3. Results of Hypothesis 1 for Total Communication Request Training (TCRT) target Chip. Start date was November 28. Number of independent sign and Signed Speech (SS) requests per every 50 requests made.

Using lowered criterion standards (i.e., accepting partial verbal responses as correct) during WRT, the child was able to reach the mastery criterion for Orange after 1,178 requests. Even after reaching mastery, however, his performance in requesting Orange was inconsistent. Although he was able to reach mastery criterion for independent requests, it later became apparent that he required periodic prompts to maintain his achieved level of independence. After mastery of Orange and the introduction of the third WRT target, Peanut, the child’s percentage of independent requests for Orange dropped to 57 percent (after 1,254 total requests). The next session Orange rose 65 percent (after 1,314 total requests). By the third session, following instruction for re-mastery, his independent requesting for Orange rose further to 76
percent (after 1,356 total requests), finally returning to mastery criterion at 80 percent by the fourth session (after 1,397 total requests).

Investigators shaped the child’s verbal approximations throughout the study. On the first day that independent requesting of the correct vowel for Orange (/oh/) was expected from the child, he produced 89 percent independent requests. Whereas “poh” was initially an acceptable response for orange, the child soon failed to use “poh” to reliably discriminate his desire for an Orange or a Peanut. At 1,721 requests, the bar was raised and the child was expected to request the item independently and provide a more discriminative request. The child’s performance initially deteriorated when shaping began. On the first session that the bar was raised his independent requesting dropped to 23 percent. The next session independent requesting dropped to 11 percent. The following session it increased to 62 percent, the next session 64 percent, and after that his performance continued to gradually improve.

Even after 3,157 instructional trials on Swing in WRT training, the child did not reach mastery criterion for Swing, or prior to achieving mastery criterion on all three of the TCRT targets. Figures 4 through 6 graph the progression of verbal requests for the WRT targets.

WRT was discontinued after the child met criterion on all three of the TCRT targets and the best treatment method (i.e., TCRT) was introduced. Orange and Peanut were put on hold from WRT training and Swing was introduced in TCRT. Following the introduction of Swing into TCRT, the child was able to achieve mastery after only 349 requests. After he achieved mastery of Swing in TCRT, Orange was introduced into TCRT. After Orange was re-introduced via TCRT, independent verbal requests,
Figure 4. Results of Hypothesis 1 for Word Request Training (WRT) target *Swing*. Start date was October 5. Number of independent verbal requests per every 50 requests made during Word Request Training (WRT). Verbal requests included any word/word sound approximations including signed speech requests declined to 0% by the 9th session (542 total TCRT requests). Independent sign requests were minimal for the first several sessions as manual prompting and shaping of the new sign was taught. Although the child showed progress, producing up to 30 percent independent requests in a session, he did not achieve mastery of *Orange* in TCRT by the end of the study. *Peanut* was not introduced via TCRT before the end of the study. Figures 7 and 8 show each of the language targets and graphs the number of independent requests for *Swing* and *Orange* in both sign and Signed Speech during TCRT.
**Figure 5.** Results of Hypothesis 1 for Word Request Training (WRT) target *Orange*. Start date was October 5. Number of independent verbal requests per every 50 requests made during Word Request Training (WRT). Verbal requests included any word/word sound approximations.

**Figure 6.** Results of Hypothesis 1 for Word Request Training (WRT) target *Peanut*. Start date was November 28. Number of independent verbal requests per every 50 requests made during WRT. Verbal requests included any word/word sound approximations.
Figure 7. Results of Hypothesis 1 for Total Communication Request Training (TCRT) target *Swing*, following transition from Word Request Training. Start date was March 2. Number of independent sign or Signed Speech (SS) requests per every block of 50 requests made during TRCT.

Results for Hypothesis 2

Hypothesis 2 predicted that increased language acquisition would affect both physical and vocal forms of stereotypy. Baseline percentages of motor and vocal stereotypy are presented in table 7 above. Due to the low frequency of motor stereotypy during baseline, data collection for this behavior was not continued beyond the baseline period. Figure 9 (see Hypothesis 3) illustrates the frequency of vocal stereotypy during the study. Vocal stereotypy remained high, at or near baseline levels, over the entire course of the study.

Results for Hypothesis 3

Hypothesis 3 predicted that increased language acquisition would be associated with decreased inappropriate behaviors associated with the mouth (i.e., vocal stereotypy and mouthing). The results showed that vocal stereotypy remained in the 72 to 100 percent range and mouthing remained in the 18 to 60 percent range. Frequency of
Figure 8. Results of Hypothesis 1 for Total Communication Request Training (TCRT) target Orange, following transition from Word Request Training. Start date was March 2. Number of independent sign or Signed Speech (SS) requests per every block of 50 requests made during TCRT.

Independent requests also varied greatly over the course of the study and did not demonstrate a consistent growth in language acquisition. It is difficult to determine how related mouthing/vocal stereotypy and language acquisition might have been because neither changed much from baseline. This suggests that there was not an identifiable relationship between language acquisition and mouthing or vocal stereotypy for this boy, according to the results of the study. This cannot be stated with certainty, though, because of the up and down pattern of language acquisition.

Results for Hypothesis 4

Hypothesis 4 predicted that frequency of tantrums would decrease as language acquisition occurred. As stated above, language acquisition did not progress consistently
Figure 9. Results of Hypothesis 3. Weekly average of daily percentage occurrence of stereotypy, mouthing, and independent requesting. enough over time to allow a clear assessment of how tantrums might or might not have been affected by language acquisition instruction. There was no detectable relationship between frequency of tantrums and language acquisition. The data are graphed in Figure 10.

Figure 10. Results of Hypothesis 4. Weekly average of hourly tantrum behavior.
Discussion

In this single case study two methods of requesting, sign and word (speech sound), were taught to a 4-year-old boy with autism. The requesting methods were taught simultaneously, in the child's home environment, utilizing a best treatment design.

Language Acquisition

Discussion of Hypothesis 1

_Swing_ and _Orange_ are the only two targets that were taught in both the word and total communication modalities. Despite the limitations of the study, the data suggest a faster rate of acquisition of language for this child using TCRT (sign/speech sound) compared with WRT (word/speech sound). The child mastered all three targets taught in TCRT by the end of the study, in addition to one of the WRT targets. In contrast, the child did not achieve reliable mastery of the WRT targets. It cannot be said with certainty that _Orange_ and _Peanut_ would have been acquired at a faster rate had they been initially taught via TCRT, but the learning of _Swing_ as a word/sound in WRT versus as a sign/sound in TCRT can be directly compared. The child did not achieve mastery of swing as a word/sound even after over 3,000 requesting trials in WRT, but achieved its mastery as a sign in TCRT after only approximately 300 requesting trials. One issue to consider is whether the prior exposure to verbal _Swing_ instruction improved the child's learning curve during TCRT. There is a question as to whether the child would have learned the Signed Speech label for _Swing/Orange_ more quickly or more slowly had he not first received intense verbal instruction on the target labels. It may be that his previous exposure to _Swing_ in WRT accelerated the rate at which the child was able to
master Swing as a sign; however, this is not likely the case. If this were the case, it would appear that that the child would have also mastered Orange quickly in TCRT, considering that he had mastered this target as a sound by the start of TCRT; instead, learning Orange proved to be even more time consuming to learn in TCRT.

Even after the intense verbal instruction, however, independent Signed Speech responses were scarce. It is not clear whether reversing the instructional order, that is, starting with TCRT and then working on verbal response after mastery (to improve Signed Speech requesting) would have yielded a similar or faster rate of acquisition of Signed Speech. It may be that the child’s previous mastery of Orange in WRT hindered his ability to shift in mental set and learn the target in a new modality, TRCT. This may also explain the decrease in verbal requests for Orange as TCRT progressed. Signed Speech requests for Orange did not increase at the rate that might be expected had the previously mastered skill of verbally requesting Orange been maintained and joined with the acquisition of the accompanying sign (resulting in Signed Speech). Also, Swing and Peanut were not mastered, likely indicating that the technique of starting with WRT and switching to TCRT does not reliably speed up the rate of acquisition of Signed Speech without prior months of foundational work building verbal response skills.

Language production as a variable proved to be much more complex to evaluate than anticipated. There are many variables to consider when measuring frequency and quality of language production. Environmental factors may have important bearing. School breaks, changes in caregiving, other demands (unrelated to the study) placed on the child, and misinterpretation of signs by those not involved in the study could and
likely did affect the rate and accuracy of our child subject's language acquisition. All of the above variables likely impacted our results and threatened the results' validity.

Transitions unrelated to study occurred throughout the 6-month study period. Full-time childcare was necessary and difficult to obtain for this family, partially because of the behavioral problems that made the child an appropriate candidate for the study. This was unfortunate because childcare and other transitions are particularly difficult for children with autism and can be associated with increased aggressive behaviors and tantrums (e.g., Sterling-Turner, 2007).

Several breaks from the child's regular school schedule also occurred during the course of the study, including several holiday breaks and spring break. During these breaks, other changes in the child's schedule were made as well, including attending a holiday camp (where he experienced problems) and having his grandmother care for him during the day.

Another major transition that occurred in the final 5 weeks of the study was the family taking the child to a new caregiver for 9 hours per week. In some ways, the introduction of this caregiver turned the study upside down. Although the caregiver attempted to maintain the integrity of the study, she introduced additional language targets (e.g., "candy," "more"). Due to the financial constraints on the family, this problem could not be dealt with. Numerous and daily communications occurred between the investigator and the new caregiver but there was only limited assistance by the caregiver in maintenance of the study's procedural integrity. This was likely the primary source of the child's decreased performance on targets mastered prior to the change in caregiver (Drink, Berry). Although the caregiver was asked and agreed to wait until the
end of the study to introduce new signs, the evidence that this was not the case was irrefutable: Although the parents and caregiver both denied that the child was being taught additional signs, the child clearly demonstrated the sign for “candy” as he requested study target items; he did not know this sign at the beginning of the study. The new caregiver also began teaching the child other skills, such as toileting. The challenge of learning the new skills may also have contributed to the deterioration in his requesting skills toward the end of the study.

It was difficult to identify how many signs the child was being taught outside of the study; both the caregiver and parents denied that other signs were being taught. The extent of the impact all of the above factors may have had on the results of the current study cannot be known.

Aside from the unplanned introduction of signs, another factor that contributed to the complexity of interpreting the results is what effect the increase in the child’s requesting vocabulary (in either sign, speech, or Signed Speech) may have had on his ability to learn additional target labels. The rate of acquisition for the later introduced targets may have been affected by the added challenge of the discrimination training necessary to maintain accuracy on each old and additional target. The more targets the child learned in either TCRT or WRT, the more room for confusion between response options he may have had. This may be the reason acquisition speed for the learning of signs slowed down with the introduction of Chip. It took over twice as many trials for the child to master Chip, compared with the first two targets that were introduced in TCRT. In addition, because the sign for Chip and Berry were both two-handed, the child may have had trouble discriminating between them. As the child learned more signs,
discrimination between the signs became more of an issue. Also, towards the end of the study the child’s Berry sign was being misinterpreted to mean “more” by his caregivers and accurate discrimination between the signs was less frequently reinforced by them.

Another difficulty was that rotating between the TCRT and WRT training appeared at times to confuse to the child. He had difficulty shifting between the different expectations of the two training modalities. The set shifting that was expected of this child may have impacted a cognitive limitation for him. Set shifting is a developing skill for all children of preschool age, and there is some evidence that set shifting is impaired in children with autism (Russo et al., 2007). TCRT provided and allowed for both verbal and nonverbal communication from both the child and the instructors but WRT only provided and allowed for the verbal representation of the target. The child often attempted to use his hands during WRT training; for example, during Orange training in the verbal modality, the child would state “oh” while simultaneously signing Berry. It seemed like the more effectively he mastered the TCRT targets (where his signing was consistently reinforced), the more he overgeneralized the use of signs to WRT training sessions. Because of this confusion, it was not possible to completely and accurately identify when the child reached the mastery criterion for Orange. Throughout the study, he continued to struggle, trying to use a known sign when requesting WRT targets, even after he verbally achieved the mastery criterion for Orange.

Similarly, during TCRT trials, the child often accompanied his (correct) sign with the verbal sounds he had practiced during WRT requesting; for example, when presented with a drink, the child would sign Drink but state “oh” for Orange. This likely contributed to his confusion as well.
Even after reaching the mastery criterion for *Orange* in WRT, the child’s performance requesting the item was inconsistent. There are several possible reasons for this. One is that the lowered mastery criterion established for WRT training (i.e., acceptance of partial verbal approximations) allowed the child to consider a variety of different responses correct. Although these were clearly outlined by the investigator, from the child’s point of view their variation may have appeared merely random. Had the child entered the study with solid verbal imitation skills, he might have better understood which sounds were expected from him during WRT. Another possible reason for the lack of continued improvement in the child’s verbal requesting over the course of the study was possible confusion with other (unofficial) targets and signs, as described above.

Another complicating factor was the misinterpretation of signs by others. This was particularly the case with the *Berry* sign, which was modified from its original version so as to require less fine motor control on the part of the child. Unfortunately, the modified sign resembled the sign for “*more*.” The misinterpretation of the *Berry* sign was discovered through direct communication with the parents, direct observation of the parents interacting with the child, and notes from the caregivers. This affected the child’s communication in several significant ways. First, the child’s requests for *Berry* were only intermittently reinforced — that is, the sign was reinforced during study sessions but not necessarily understood and reinforced in the child’s natural environment. The child was not receiving the requested item at home when he signed *Berry*, but likely more of what he had just had. Second, scrolling through signs was inadvertently reinforced at home. On one occasion, the child’s parents informed the investigator that their child had signed “*more swing*” all weekend. Even when they were reminded that the child did not know
and had never learned the sign for "more," his parents continued to interpret the Berry sign as "more" and reinforce it as if it meant "more." This could potentially have led to increased tantrumming, as the child's requests were not heeded and mastered targets became confused.

Language and Behavior

Discussion of Hypothesis 3

Hypothesis 3 directly examined the relationship between vocal stereotypy and language acquisition. Language acquisition was defined as independent requesting. There does not appear to have been a relationship between the acquisition of independent requesting skills and vocal stereotypy. Interpretation of the data is complex, though. A possible relationship between the two variables cannot be ruled out, for three reasons. First, the study was not designed so as to differentiate between stereotypy data that was taken during WRT and data taken during TCRT. It may very well have been that stereotypy decreased during verbal instruction training, when the child was engaged in meaningful verbal exchange and inappropriate vocalizations would have been incompatible with word requesting. In the form the data was collected, though, there was no evidence of a meaningful change in the percentage of time spent engaging in vocal stereotypy as independent requests increased in frequency.

A second issue to consider is that most of the independent requests were produced in sign. It would have been possible for the child to sign the appropriate request and simultaneously engage in vocal stereotypy. Because signing does not require a verbal response, there is no obvious incompatibility between signing and vocal stereotypy. The
exception to this would be during Signed Speech, in which both sign and a verbal request was produced.

Third, the child did not steadily acquire the language taught; there was not an increase in frequency of independent responding over the course of the study. It is difficult to know whether vocal stereotypy would have decreased had language acquisition been steady and/or on the upswing. It may be that given more time and increased mastery of the target labels, vocal stereotypy would have eventually decreased in frequency.

The second part of the hypothesis predicted a decrease in mouthing as language acquisition progressed. Mouthing did at times decrease in frequency during the study, but also returned to baseline levels at times. The same issues discussed concerning vocal stereotypy could also have created difficulties accurately establishing the relationship between language acquisition and mouthing. Data would need to be taken separately based on the method of instruction and method of requesting, and steady language acquisition would have to be demonstrated before its relationship to mouthing could be assessed.

*Discussion of Hypothesis 4*

Tantrums were relatively rare throughout the study. There was a peak during the 16th week of the study, when tantrums occurred an average of once per hour. External conditions, more than the acquisition of language, appeared to affect the rate of tantrumming. During the week that tantrums were at their peak, the child was on break from school and placed in a “Christmas camp.” As discussed earlier, transitions are particularly difficult for children with autism. Parents reported that the child engaged in
several aggressive and inappropriate behaviors during his stay at the camp. They were required to accompany him the remainder of the week to prevent his expulsion.

Due to the confusion on the part of both the child and his parents that can accompany language acquisition, as described above, it is possible that the impairment in the child’s language as a function of instruction may have actually maintained his frustration over his inability to communicate his desire. Learning language is hard, and likely was stressful for this child. We added new labels and continued to work on shaping his verbal approximations for WRT targets, as we taught sign requests. It is possible that this increased the child’s daily frustration, potentially leading to more tantrums, either related to language learning or related to other events in his life, where a decrease in frequency of tantrums would otherwise be expected. More data would need to be collected on tantrumming over a longer period of time in order to see a change. It was still early in the language learning process to expect the child not to encounter frustrations associated with learning new skills. What happened with this child may be similar to what occurred in Barrera and Sulzer-Azaroff’s (1983) study, in which increased disruptive behaviors were observed in one of their participants. For some children, the demands of the language acquisition trials did not outweigh the value of the rewards obtained for correct responding.

Another issue is that a tantrum was narrowly defined as lasting more than 1 minute, which eliminated the inclusion of kicking, screaming, etc. lasting less than 1 minute. It may be that the frequency of child’s tantrums, as defined in this study, did not significantly change over time; whether frequency of shorter disruptive outbursts changed or not was not assessed.
Limitations

A major limitation that affected this study was the lack of the investigator's control over the child's home and learning environments unrelated, or related, to the study. Four-and-a-half months into the study, the child's parents hired a tutor to work with him three times per week for 3 hours. It became clear that the tutor's methods of instruction were incongruent with and even counterproductive to the study treatment methods. Points of disagreement included the when and how of the introduction of new targets and the limit on the number of targets the child was receiving instruction on at one time.

Using a single subject for the study was also a limitation. Results may not generalize to other children with autism. At the end of the study, recommendations were provided for the family to help them help their child continue to build upon the gains made during the study. The letter delivered to the family including the recommendations is in the Appendix.
References


APPENDIX

Pacific University SPP
222 SE 8th Avenue
Hillsboro, OR 27123

April 4, 2007

Dear [Parents],

Thank you for your participation in the study. It has been a pleasure working with you and [Child] these past 6 months. The preliminary results suggest that the use of signed speech is the more effective intervention for [Child]'s communication development. The following are recommendations based on the preliminary results of the study.

1. [Child] and those who interact with him would benefit from continued practice and use of the signs he acquired during the study, in order to promote further discrimination and fluency and prevent regression in skills.
   a. Increased receptive exposure to signs may also improve [Child]'s comprehension of spoken language.

2. As his imitation skills develop, [Child] may be able to learn new signs incidentally. For the time being, however, the introduction of new signs into [Child]'s expressive vocabulary should be systematic and only one at a time.
   a. Systematic introduction includes physically molding [Child]'s hand into the appropriate sign and then immediately providing the requested item. It may take hundreds of repetitions of the above procedure before [Child] is able to spontaneously use the sign or even form it on his own.
   b. Confusion, overgeneralization, and scrolling are big issues with [Child]. Discrimination training may need to take place before [Child] really learns the sign. This means that he only uses the sign for the corresponding item and does not incorrectly use the sign to request other items. This would require systematically allowing access to 2 items that [Child] is confusing and repeatedly helping him to differentiate the two.
   c. Criterion should be set for when [Child] is considered ready to learn a new sign. (For example, during the study the criterion was 80% correct use of the sign over 20 requests.)
   d. [Child] has demonstrated the potential to have a large sign vocabulary. Sign that he is learning should be as specific as possible, to encourage a large vocabulary. General signs (such as “more,” “eat,” and “go”) tend to be used as catch-all words that can ultimately limit [Child]'s desire to communicate his specific needs and wants. These types of words should only be used in phrases, such as “more orange” or “go outside.”

3. [Child] would benefit from intensive exploration of his potential for speech production.
a. This entails roughly 6 months of systematic and intensive verbal imitation instruction. For best results, a minimum of 2 hours per day, 7 days per week is preferable. With less than 1 hour per day, 7 days per week, [Child] is not likely to make any progress.
b. Good sounds to start with are ones that [Child] already knows how to make but has little imitative control over, such as /oh/, /bi/, /ee/.
c. It may be helpful to start with sounds that he has associated with signs, but increasing his motivation to speak by requiring a relevant vocalization along with the sign (For example, requiring [Child] to say /bi/ in addition to signing berry before he is given a berry).
d. If you so desire, Dr. Schaeffer can try to recruit a psychology graduate student to continue research with [Child] and help you develop and implement the above recommendation; however, there is no guarantee that he will be able to find a student to help you, and if he does, the student may not be in a position to begin research for up to 1 year. For this reason, it is highly recommended that you begin practicing vocal imitation with [Child] as described above as soon as possible so as not to lose valuable time and momentum. Regardless of whether another student continues formal research with [Child], Dr. Schaeffer and Caroline will continue to collaborate.

4. [Child] and those who interact with him would benefit from the development of consistent behavior management plan with well-specified procedures. Examples of specific procedures might include the following.
   a. Requiring [Child] to follow through with instructions.
   b. Ignoring small-scale disruptive behaviors (i.e., physically turning away or leaving the scene, no smiling, talking to [Child], or eye contact with him)
   c. Time out for aggressive behaviors (i.e., [Child] must sit or stand against the wall until 20 seconds quiet)
   d. If distraction is used, be careful that it does not function to inadvertently reward bad behavior. For example, asking [Child] if he wants ice cream or taking him outside to play when he is tantrumming may inadvertently teach him to tantrum when he wants special attention or tasty treats.

5. If you are uncertain, confused, or interested in finding out where [Child] is with his progress, data collection over the course of a few days is an excellent method of assessing and tracking [Child]'s skills.

Best wishes,

Cynthia Polance, M.S.  Benson Schaeffer, Ph.D.  Caroline Rose
Principal Investigator  Faculty supervisor  Research Assistant