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TEACHING FUNCTIONAL USE OF AN EYE GAZE COMMUNICATION BOARD TO A CHILD WITH MULTIPLE DISABILITIES

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Introduction

Limited speech is characteristic of developmental disability (Blackwell *et al.*, 1989). As a result, persons with developmental disabilities may be candidates for sign language training or instruction on the use of a picture-based communication board (Reichle *et al.*, 1991b). When planning alternative communication intervention it is necessary to select an appropriate mode of communication. This decision is based, in part, on the physical abilities of the learner (Goetz and Hunt, 1994). That is, does the child have the motor skills needed to communicate in that particular mode? Because many children in need of alternative communication have physical as well as intellectual limitations (i.e. multiple disabilities), sign language or pointing to pictures on a communication board may be contraindicated. For these learners, a communication system based on eye gaze responding may respresent a viable option (Bigge, 1991).

An eye gaze communication system typically involves the use of a transparent ETRAN Chart (Eicher, 1973; Silverman, 1980). This is often simply a square piece of clear plexiglass with a hole cut from the centre (Beukelman and Mirenda, 1992; Orelove and Sobsey, 1991). Photographs or line drawings relevant to the child's wants and needs can be affixed to each corner of the board. To communicate, the child is taught to look at one of the symbols for an extended period of time (e.g. 3 secs.). During communicative interactions, the transparent chart is situated between the child and the observer. The hole in the centre of the chart enables the

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observer to determine what symbol the child has "selected". Eye gaze is useful for children with severe physical limitations because it requires only that they be capable of fixing their gaze onto one of the pictures affixed to the chart.

The mere provision of an eye gaze chart is not always sufficient to ensure functional communication. Children with multiple disabilities typically require systematic instruction to acquire functional communication skills. Intervention might begin by teaching the child to request a needed object (Reichle *et al.*, 1991a). If the child enjoys listening to music, for example, he or she might be taught to request a cassette tape, a tape player and the required headphones. Specifically, the child might be given a cassette tape and a tape player, but not the required headphones. This creates an opportunity for the child to request the needed headphones by gazing at the relevant photograph on the chart. Studies have demonstrated that children with developmental disabilities can be taught to request needed, but missing objects using picture-based communication boards (Sigafoos *et al.*, 1989; Sigafoos *et al.*, 1990). However, empirical demonstrations of functional eye gaze communication are lacking. Most accounts of the ETRAN system, for example, are descriptive or anecdotal (e.g. Eicher, 1973; King, 1990; Silverman, 1980). The purpose of the present study, therefore, was to provide a data-based account of teaching functional use of an eye gaze communication board to a child with multiple disabilities.

Method

Participant

Tim was selected for this study because he did not speak and his physical disabilities contra-indicated the use of sign language. Furthermore, attempts to use a picture-based communication board were unsuccessful owing to his limited pointing ability. Tim was six years old. His school records included a diagnosis of moderate intellectual disability. In addition, Tim had severe cerebral palsy. As a result he did not walk, but instead used a wheelchair. He also had very poor control over his hands and arms and required assistance with dressing, eating, toileting and most other self-care, academic and motor tasks. However, he was able to direct his gaze to various indicated locations and was said to understand various spoken commands (e.g. "Look", "Stop").

Tim's adaptive behaviour was assessed by his classroom teacher using the TARC Assessment Inventory (Sailor and Mix, 1975). This device was developed on a sample of 283 severely handicapped children from 3 to 16 years of age. It yields an overall standard score with a mean of 50 and a standard deviation of 20. Tim obtained an overall standard score of 35, which placed him within one standard deviation of the mean when compared to other children with severe disabilities.

Setting

The procedures were implemented in a one-to-one teaching situation by a certified special education teacher affiliated with this project. Teaching sessions were conducted at a table in one of two classrooms. Sessions were usually conducted three mornings per week, although some sessions had to be postponed owing to Tim's absence. Tim attended a special school for 62 children with multiple disabilities. In his classroom were seven other children and the staff consisted of two teachers and up to three teaching assistants. Support services were available from physio-, occupational- and speech-therapists.

Activity

Teaching sessions occurred in the context of a preferred leisure activity. Specifically, the study focussed on teaching Tim to request the items needed to listen to his favourite cassette tape using a portable tape player with headphones. A pre-baseline assessment indicated that listening to music was a preferred activity for Tim. As an indication of preference, Tim always allowed the trainer to place the headphones on his head and he would often smile as the music was playing.

Another pre-baseline assessment was conducted to ascertain that Tim could identify the three needed items for the music activity (i.e. the cassette tape, headphones and tape player). During this assessment, Tim was given two of the three items. The missing item was then placed on the table together with two unrelated items (e.g. a paint brush and some paper). A 10 second observation was then made to determine if Tim would select the correct item from the array of items. For example, on one trial Tim might be given the tape and player, and the headphones then placed on the table with the two unrelated items. Six such trials were conducted per day with each item serving as the missing object on two trials in a mixed order. If Tim selected the required item from the array, he was allowed to listen to music for approximately 30 seconds. If Tim did not select the required item within 10 seconds, he was physically assisted to select that item. Because Tim was often unable to physically grab the required item from the table, any attempt to reach towards the needed item was accepted as a correct selection. This assessment continued until Tim had made three consecutive correct selections.

Eye Gaze Chart

Tim's eye gaze chart was made from a sheet of clear plexiglas. It measured 55 x 45 cm. One colour photograph was placed in each corner of the chart. Each photograph measured 13 x 9 cm. The photographs were mounted on a cardboard frame. Velcro was used to affix these frames to the chart. This allowed the position of the photographs to be randomised before each session. Three of these photographs depicted one of the actual items needed to listen to

music (i.e. cassette tape, tape player, headphones). The fourth photograph, showing a can of paint, served as a foil. The name of the item depicted in each photograph was printed on the bottom of each cardboard frame. A 31 x 21 cm rectangle was cut from the centre of the plexiglass. This enabled the teacher to observe Tim's eye gaze response.

Design and Procedure

Items were arranged into three combinations. *Relationship A* consisted of giving Tim the tape and tape player. In this relationship, the headphones were missing and, therefore, needed to be requested before he could listen to music. *Relationship B* consisted of giving Tim the headphones and tape. This created the need for Tim to request the missing tape player. For *Relationship C*, Tim was given the tape player and the headphones, with a resulting need to request the missing cassette tape.

Sessions consisting of four to six discrete trials were conducted three days per week. Sessions involved either one or a combination of the three relationships, depending on the phase of the study. The initial baseline phase, involving all three relationships, was followed by an intervention phase during which Tim was taught to request the missing headphones when given the tape and tape player (i.e. *Relationship A*). After Tim had acquired *Relationship A,* tests were conducted to determine if his performance on *Relationship B* and *C* had improved. After these tests, a further intervention phase was begun to establish *Relationship B.*

The study consisted of five sequential steps as described below.

1) Baseline. Baseline sessions consisted of six opportunities. Two opportunities for each relationship (*A, B* and *C*) were provided in a mixed order. Trials were conducted in a spaced-trial format. That is, approximately 80 seconds separated each trial with no intervening activities other than allowing Tim to listen to music. To begin each trial, the teacher placed two of the required items in front of Tim on his wheelchair laptray. The eye chart was then situated between Tim and the teacher. The chart was held by the teacher so that its centre was at eye level for Tim. Up to 10 seconds were allowed for Tim to make a correct request for the missing item. The missing item was not visible during this 10 second interval. A correct, "spontaneous" request was recorded if Tim fixed his gaze on the photograph of the missing item for full 3 seconds. If his gaze did not last at least 3 seconds or if he looked at a different photograph for 3 seconds or more, the response was considered incorrect. At the end of the 10 second interval, Tim was given the missing item and could listen to music for 60 seconds. After this, one of the items was removed and the next trial initiated about 10 seconds later. During baseline sessions, Tim always received the missing item after 10 seconds regardless of whether or not he had produced a correct, spontaneous request. This practice was followed because few correct requests were expected during

baseline sessions, owing to the fact that Tim had no prior experience with this mode of communication. Thus "non-contingent" reinforcement was provided during baseline session to maintain his interest and cooperation.

2) Intervention. Intervention sessions consisted of four to six trials. All trials involved *Relationship A*. That is, Tim was given the cassette tape and tape player and needed to request the missing headphones. In other respects, intervention trials were identical to baseline opportunities with the following exceptions. Correct, spontaneous requests were reinforced immediately by giving Tim the headphones and allowing him to listen to music for 60 seconds. If a correct request did not occur within 10 seconds, Tim was prompted. Prompting consisted of giving him verbal cues (i.e. "What do you need?") followed by a verbal cue plus stimulus prompting if needed (i.e., while asking "What do you need?", the teacher tapped the correct photograph with her finger). After prompting a correct request, Tim was given the headphones and allowed to listen for 60 seconds. However, if a correct request failed to occur even with prompting, an error correction procedure was implemented. During this procedure, the teacher held up the actual headphones and asked "What is this?". If Tim then looked at the correct photograph he received verbal praise only (e.g., "That's right, headphones."). If a correct request still did not occur, stimulus prompting was added to the error correction procedure. Thus, in contrast to baseline, receipt of the headphones during intervention was contingent upon producing a correct request. However, only correct requests that occurred within 10 seconds of being given the tape and player and before verbal cues were given, were recorded as spontaneous.

3) 30 Second Delay. After eight sessions, the intervention procedures were modified in response to Tim's dependence on verbal cues. That is, the raw data indicated that Tim required a verbal prompt on about half the trials. The delay interval was, therefore, extended from 10 to 30 seconds in an effort to fade his dependence on verbal cues. Specifically, after giving Tim the cassette and tape player, the teacher waited up to 30 seconds for Tim to produce a correct spontaneous request. All other aspects of intervention remained the same. Midway through this phase, Tim was absent from school for 2 weeks (see FIGURE 1).

4) Test. After Tim had acquired *Relationship A*, tests were conducted to determine if *Relationships B* and *C* had emerged without direct intervention. Tests were conducted in a manner identical to baseline session, except that Tim only received the missing item if he produced a correct, spontaneous request. Both relationships were tested 17 times over six daily sessions of five or six trials.

5) Teach Relationship B. After testing, intervention was extended to *Relationship B*. That is, Tim was given the headphones and a cassette tape and thus needed to request the missing tape player. The procedures were identical to

those of the initial intervention phase. Unfortunately, the study came to a premature end due to another lengthy absence by Tim. In addition, the school year ended shortly after his return.

Interobserver Agreement

An independent observer collected reliability data on Tim's performance during all phases of the study. Specifically, 33% of the baseline sessions were scored for reliability. Instances of agreement and disagreement were noted on a trial by trial basis. The overall percentage of agreement, based on the formula: Agreements/(Agreements + Disagreements) x 100%, was 75%. During intervention, 87% of the sessions were scored for reliability with 95% agreement. During the subsequent tests, 40% of the sessions were independently observed with agreement at 83%. Finally, reliability data were collected on half of the Teach Relationship B sessions with 87% agreement obtained.

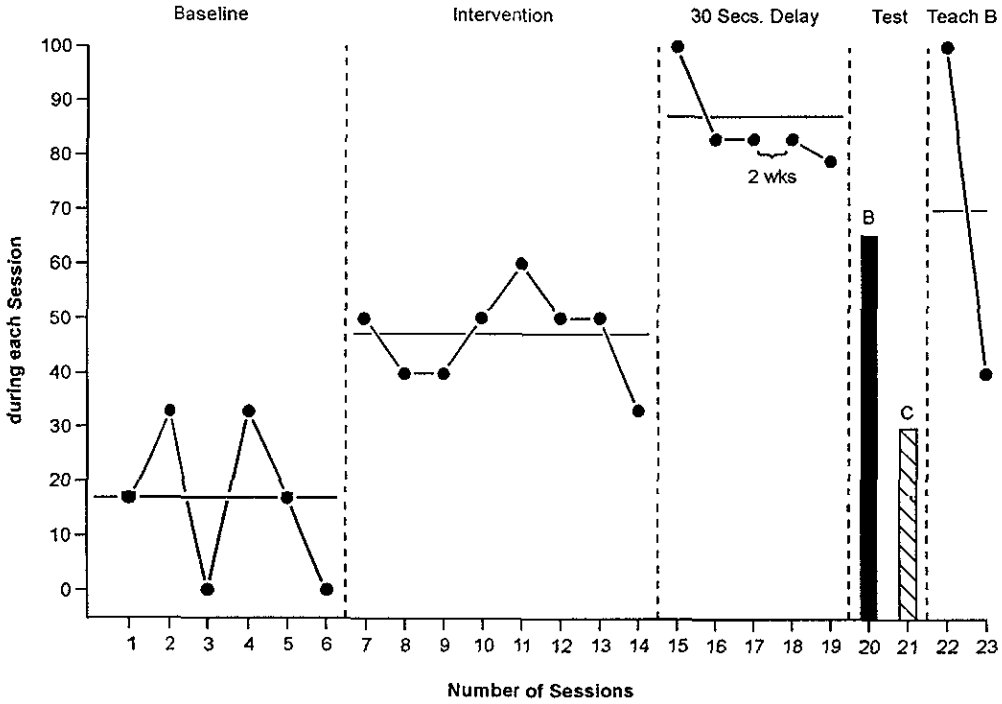
Results

FIGURE 1 shows the percentage of trials with a correct, spontaneous request during each phase of the study. The average for each phase is indicated by the solid horizontal line. For example, Tim's average during baseline session was 16.66% which is below chance level responding (25%). He also showed a decreasing trend over the last three baseline sessions. During baseline session, Tim received all three types of trials. In addition, a 10 second delay was used, but there was no prompting. At the end of each baseline trial, Tim was given the missing item and allowed to listen to music for 60 seconds regardless of whether or not a correct response had occurred (i.e., reinforcement was noncontingent).

When intervention began to teach *Relationship A* (i.e., request missing headphones when given the cassette tape and tape player), the percentage of trials with a correct spontaneous request for the missing headphones increased. The percentage of correct, spontaneous requests remained relatively stable at roughly 50% throughout this initial intervention phase (i.e., during Sessions 7-14 as shown in FIGURE 1). That is, Tim produced a correct, spontaneous request on about half the trials. A correct, spontaneous request was only counted if Tim looked at the photograph of the missing item within 10 seconds. If the required request did not occur independently within 10 seconds, Tim was prompted to make the request. On those trials when Tim did not request spontaneously (i.e., within 10 seconds and without prompting), he typically responded correctly after the teacher provided the verbal prompt, "What do you need?". Unlike baseline session, Tim received the missing item contingent upon a correct, spontaneous request and also if he responded correctly after prompting.

Because Tim appeared to wait for the verbal prompt on about half of these initial intervention trials, the delay interval

FIGURE 1
Assessment of Learned Eye Gaze Communication



KEY TO FIGURE 1

Sessions	3 days per week, 4 - 6 trials per session
Baseline	2 trials per Relationship, total of 6 trials with 10 seconds to respond without prompting or error correction, with reinforcement at end
Intervention	teaching to request headphones (Relationship A) with 10 seconds to respond with prompting and error correction and reinforcement contingent on correct response
30 Seconds Delay	to fade verbal prompting
Test	17 trials on Relationship B and C, all identical to baseline session, but with reinforcement for correct, spontaneous request
Teach B	teaching Relationship B, identical to Intervention

was extended to 30 seconds to fade the prompt. The 30 seconds delay was used during Sessions 15-19 as shown in FIGURE 1. With this extended delay interval, correct, spontaneous requesting increased and remained at or above 80% even after a two week absence.

After intervention to teach *Relationship A*, 17 trials were conducted during which Tim was given the headphones and cassette tape and tested to see if he would request the missing tape player (i.e., *Relationship B*). Similarly, 17 test trials were conducted on *Relationship C* (i.e., Would Tim request the missing cassette tape when given the tape player and the headphones?). These tests were designed to assess transfer from *Relationship A* to *Relationships B* and *C*. Test procedures were similar to baseline, except that reinforcement was only given for correct, spontaneous requests. Results from these tests are presented as the percentage correct out of the 17 trials and are indicated by the two bars in the fourth phase of FIGURE 1 (i.e., Sessions 20 and 21). The tests indicated some improvement over baseline, most noticeably for *Relationship B*. Over the 17 test trials, Tim produced a correct, spontaneous request for the missing tape player (*Relationship B*) on 65% of the trials and for the missing cassette tape (*Relationship C*) on 30% of the trials. Both percentages are above chance and above the baseline average, suggesting some degree of transfer from *Relationship A* to *Relationships B* and C.

After testing, intervention began on *Relationship B*. This final phase replicated the procedures used during the initial intervention with *Relationship A*. Specifically, Tim was given the headphones and cassette tape and allowed 10 seconds to request the missing tape player. After 10 seconds, prompting was used if a correct, spontaneous request had not occurred. Reinforcement was given only after a correct request whether spontaneous or prompted. As shown in FIGURE 1 (Sessions 22 and 23), his average during this phase was slightly above that obtained during the test, suggesting a possible intervention effect. However, only two sessions could be completed before the study ended.

Discussion

The present study demonstrated rapid acquisition of functional communication skills in a young boy with multiple disabilities. These results provide much needed empirical support for existing - yet mainly descriptive and anecdotal - accounts of eye gaze communication among persons with severe handicaps (Eicher, 1973; King, 1990; Silverman, 1980). In addition, Tim's results suggest that intervention to establish an eye gaze communication system can begin by teaching requests for missing items (Cipani, 1988). Other studies have shown that children with severe disabilities can be taught to request missing items as an inital communication skill (Sigafoos *et al.*, 1989; 1990). In these other studies, the requesting response consisted of pointing to pictures on a communication board. The present results extend previous studies by

showing that eye gaze, in combination with an ETRAN chart, can be established as a reliable means of requesting missing items. This is important because it suggests that functional communication skills can be targeted for instruction from the very beginning of intervention, even when an alternative mode of responding is required (Reichle and Sigafoos, 1994).

Several factors may have contributed to Tim's rapid acquisition of functional eye gaze communication. First, listening to music appeared to represent a preferred activity for Tim. A correct request for the missing item enabled Tim to access a highly preferred activity. This rather natural and specific reinforcement (Ferster, 1967; Reichle *et al.*, 1986) may have facilitated acquisition. Second, withholding one of the needed items may have produced a motivational boost in that it created a real need for communication (Sosne *et al.*, 1979). Third, although Tim had no prior experience with the ETRAN chart, he did make good eye contact and would look at things when asked. These existing skills may have contributed to his rapid acquisition. That is, instead of needing to develop a completely new behaviour, intervention focused on getting an existing topography to occur when the opportunity arose. However, additional research is needed to determine exactly how the acquisition of functional communication skills is influenced by whether or not the required topography is part of the learner's existing repertoire.

In any event, the results of the present study suggest that structured intervention produced an increase in correct requesting. Yet, highly structured intervention sessions could potentially limit maintenance and generalisation (Halle, 1988). Although long-term maintenance could not be assessed, Tim maintained his previously high level of performance even after a two week absence. This result indicates at least some short-term maintenance. His performance during the test phase also suggested some degree of generalisation. That is, after learning *Relationship A*, Tim showed some improvement on *Relationships B* and *C* during testing. However, the nature of the baseline - testing sequence makes it difficult to determine the factors responsible for the observed improvement. Nonetheless, his results are consistent with another recent study (Sigafoos *et al.*, in press). In this study, children with multiple disabilities were taught to request missing items by pointing to pictures on a communication board. After learning one relationship (e.g., request A when given B) there was often more rapid acquisition and sometimes even spontaneous improvement when tested on the reciprocal relationship (i.e., request B when given A). Perhaps this type of transfer occurs because, with both eye gazing and pointing, the topography of the requesting response is similar regardless of whether one is requesting the cassette tape, the tape player, or the headphones, for example.

Tim's performance only reached a high level when the delay interval was extended to 30 seconds. This change was made because it became clear during the initial intervention phase that

Tim often simply waited for a verbal prompt before making his request. The intervention procedures were thus modified in an attempt to fade this apparent prompt dependency. The immediate improvement associated with this change highlights the importance of making procedural modifications based on analysis of the learner's performance.

Several limitations necessitate a cautious interpretation of the results. First, the study involved only one child which limits its generality. In addition, while intervention was associated with increased requesting, the case study nature of the design does not rule out alternative explanations for Tim's improvement. However, the results are consistent with a growing number of studies documenting the effectiveness of similar procedures for teaching alternative communication skills to children with developmental disabilities (e.g., Duker and Moonen, 1986; Hall and Sundberg, 1987; Hunt *et al.*, 1986). And, given the close association between the onset of intervention and increased requesting, it seems most likely that Tim's improvement was in fact a product of intervention. A third limitation stems from our inability to complete the study due to another absence by Tim followed by the close of the school year. Such are the practical constraints of applied research. Despite these limitations the results of the present study were promising and suggest the value of further empirical demonstrations on teaching eye gaze communication.

Summary

Eye gaze may represent a viable mode of communication for children with multiple disabilities, yet there are few empirical studies on teaching its use. In this study, a young boy with severe physical and moderate intellectual disability was taught to request missing items by looking at photographs on a transparent ETRAN chart. Initially, the child was taught to request the missing headphones when given a cassette tape and a portable tape player, so that he could then listen to music. A request consisted of looking at the correct photograph from a set of four. Verbal and gestural cues were used to prompt correct requests initially. When a 30 second time delay was added, requests occurred without prompting during more than 80% of the opportunities. Following acquisition of this initial response, some requests for the other two items occurred when these were withheld. The results provide empirical support for existing, yet mainly descriptive accounts of eye gaze communication.

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