Comparing the Acquisition Rates of Stimulus Presentation in Discrete Trials: Table-top vs. Scan-board

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Abstract
Many researchers have investigated ways to improve the skill acquisition of students with developmental disabilities. Discrete trial teaching is one technique that has been shown to help students with developmental disabilities learn.
Although there are many different approaches to teaching students to acquire new skills, there is a lack of research comparing stimuli presentations during discrete trials. The purpose of the present study is to compare the acquisition rate of sight words for three students with Autism when stimuli are presented either horizontally on a tabletop or vertically on a scan-board using a changing criterion design. Results of this study indicated that stimulus presentation remains differential among individuals. It remains important to differ stimuli presentation in discrete trials to see which stimulus presentation for each individual may improve acquisition rates. The results of this study also provide opportunities to continue research in the area of stimulus presentation, discrete trials, and acquisition rates.
Introduction

Students with developmental disabilities often show a slow acquisition of skills. Students often learn best when skills are broken down into smaller steps (e.g. via a task analysis) or when instructional stimuli are presented in mass trials (e.g. via discrete trials). Discrete trial training (DTT) is a method for individualizing and simplifying instruction to enhance a student’s learning (Smith, T., 2001). For individuals with developmental disabilities discrete trial training can be especially useful in creating new forms of behaviors and new discriminations (Smith, T., 2001). For learning to occur in discrete trial teaching, the student must attend to and be able to discriminate the stimulus that the experimenter has designated as correct. When this does not occur, the target response is not likely to emerge and the new skill being taught is unlikely to be maintained. Although research has been conducted regarding how to control individuals’ attention to and discrimination of specific stimuli, little research exists pertaining to manipulation of stimulus presentation.

A small number of studies have compared stimuli skill acquisition rates when stimuli were presented in a traditional table-top format vs. stimuli presented on a computer screen. Kelly et al. in 1998 investigated comparing computer vs. tabletop teaching methods using visual-visual matching with a five year-old boy with autism. The researchers tested visual to visual matching on the computer and compared the results to those generalized on the table-top. The study was preformed using a changing criterion design. The results showed that the
participant performed the identity matching with 90% accuracy on the computer, but maintained a much lower level of accuracy when presented with the same stimuli on the tabletop. The reason for this discrepancy is undetermined. It is possible that the presentation was more captivating to the learner, thus the learner’s prior history with the computer may have influenced his behavior. Also, the stimuli on the computer screen were placed horizontally in front of the student rather than vertically.

Clark & Green (2004) compared two stimulus presentations during discrete trial instruction: an auditory sample delivered by the instructor, and an auditory sample delivered by a micro-computer. The results indicated that four out of five participants acquired the word/symbol relationship faster in the microcomputer condition than when the instructor verbally gave the participant the word cues. This unique stimulus presentation shows that varying stimulus conditions can affect the acquisition rates of students with developmental disabilities. As one might imagine, there are a multitude of ways to vary stimulus presentations.

Another study conducted by William et al in 2002 investigated the level of motivation and the rate of maladaptive behaviors in several children with autism. In this study reading on the computer was compared to reading a book in eight children with autism. The children varied from age 3 to 5. The results showed that five out of eight participants displayed an increase in their on-task behavior and a decrease in their maladaptive behaviors when using the computer. The researchers stated that every individual attended to the music and sounds coming from the computer, but that individuals became off task more quickly when reading a book
with the teacher (William et al., 2002). Although this study did not provide information on skill acquisition and stimulus presentation it does give the researcher a broader view of on-task and off-task behavior in children with developmental disabilities, which can also effect skill acquisition rates in discrete trial presentations.

Discrete trial instruction is a procedure that experimenters and teachers implement to teach new skills to students with developmental disabilities. This procedure has been found to be highly successful in teaching students new skills (Smith, T., 2001). Typically, stimuli are presented in a tabletop format, however, it is possible that other stimulus presentations may be more effective in promoting skill acquisition. While research has been conducted comparing the acquisition rates of children learning using stimuli presented on the tabletop vs. computer, other aspects of the stimulus presentation have not been examined. The following study compares the acquisition rates of students’ when presented with both horizontal and vertical stimulus presentations using both a table-top and scan-board format.

Method

Participants
There were a total of three participants, all male, ages ten, eleven, and thirteen. Each participant was diagnosed with Autism or Pervasive Developmental Disorder. The participants all lived and were schooled at an institute specializing in teaching children with Autism Spectrum Disorders. The school specialized in instruction based on the principles of Applied Behavior Analysis as it’s primary methodology for teaching students. The participant’s names were Jimmy, Charlie,
and Danny. Jimmy was ten years old, a non-verbal communicator who primarily used modified American Sign Language the Pictorial Exchange Communication System (PECS). Charlie was thirteen years old, who primarily communicated through one to three word utterances such as, “Gummy please,” or “I need help.” Danny was eleven years old, a non-verbal communicator who primarily used a PECS communication book to express his wants and needs. To be considered a participant in this study, the participants were required to demonstrate several prerequisite skills. Prerequisite skills included identity matching, and the ability to also complete a multiple-stimulus preference assessment. The preference assessment contained eight varying types of edibles in a randomized array of three. The highest preferred items from the preference assessment were used as the edible reinforcement for the correct answers.

Materials

Materials included two chairs, a table, and a scan-board made out of cardboard 10x5 inches in length with two pieces of Velcro on opposite ends. Each session was conducted in the student’s classroom at the student’s assigned table. No other students were at the testing table during test sessions. Four sight-words were chosen for their functionality and the ability to be generalized in other settings. Both words chosen were novel to the participant, which was determined during baseline sessions. Each sight word was typed in black on a laminated 3x3 piece of white construction paper. The sight words chosen included: “danger”, “exit”, “hazard”, and “caution”. Along with these materials, the experimenter also
used a randomized stimuli placement sheet, a ten-trial data sheet, and a sheet indicating the correct prompt hierarchy procedures.

Procedure

*Scan-board Trials:* Each participant was seated at a table in the classroom with the teacher sitting on the opposite side of the table. The teacher waited until the participant demonstrated appropriate on-task behavior. On-task behavior was defined as when the participant was sitting at the table, with folded hands and was looking at the instructor. The teacher presented the participant with a two stimuli array on the scan-board with an array of two stimuli on each trial presentation. If the participant’s accuracy was less than 80% accuracy across three baseline sessions, then the sight-word was considered unfamiliar to the individual and was then used during teaching trials. Baseline sessions included ten trials, in which stimuli were presented in a randomized order. When teaching sessions began each response was recorded on a 10 trial data sheet as either a correct and incorrect answer.

The target stimulus were taught using an errorless teaching procedure, using a most-to-least physical prompt hierarchy. The prompt hierarchy included five levels: 1) immediate full physical at the hand; 2) immediate full physical at the wrist; 3) immediate full physical at the forearm; 4) immediate shadow at the shoulder; and 5) independent response. Criteria to increase levels was met when the student demonstrated 80% accuracy across three sessions at the prescribed prompt hierarchy. Once the participant demonstrated 80% accuracy for three sessions independently, the experimenter in a separate classroom conducted follow-up generalization sessions. The participant was considered to have achieved mastery if
he averaged 80% accuracy and independence over three consecutive sessions in
generalization.

Due to the errorless learning teaching procedure used in this experiment, the
participant could not emit an error until level five, when the participant answered
independently. When the participant reached level five, the correction procedure
implemented by the experimenter included blocking the incorrect response. If the
response was unsuccessfully blocked, then a full physical prompt at the wrist was
used to show the participant the correct answer. For every correct response the
participant would receive one edible reward identified via preference assessment.

_Tabletop Trials:_

The procedure for tabletop trials was exactly the same as the above
procedure with the exception of how the stimuli were presented to the participant.
Prompt-hierarchy, data collection, stimulus array, correction procedure, and
reinforcement were run exactly the same as above. Instead of using a scan-board,
the stimuli were placed on the table six inches apart in front of the participant.
Criteria for mastery during table-top trials was also the same as the mastery
criterion in effect during scan-board presentation.

_Procedural Integrity/ Inter-observer Agreement:_

A changing criterion design across participants was used to compare skill
acquisition during scan-board trials and table-top trials. The prompt hierarchy
criterion was set to change to a less intrusive physical prompt for each participant
after three sessions of 80% accuracy or higher. Inter-observer agreement data were
collected for 77.7% of all sessions and ranged from 90% to 100% with an average
of 98% across sessions. Procedural integrity data were taken during 70% of all sessions and ranged from 90% to 100% with an average of 99% across sessions.

Results

The results showed that the number of sessions required to achieve mastery of sight words varied by participant. Participant Jimmy was able to acquire the sight word "enter" on the scan-board after 25 teaching sessions (Figure 1). Jimmy was able to acquire the sight word “hazard” on the table-top after 30 teaching sessions (Figure 2). Participant Charlie acquired the sight-word “Danger” on the scan-board after 18 sessions (Figure 3). Charlie was also able to master the sight word “Caution” on the tabletop after 18 sessions (Figure 4). Participant Danny acquired mastery of the sight word “Caution” on the scan-board after 25 teaching sessions, and mastered the sight word “Enter” on the table-top after 22 sessions (Figure 5&6).

Three patterns emerged: one participant, Charlie, acquired the functional sight words at the same rate in both the tabletop and scan-board stimulus presentations. Participant Jimmy acquired the sight word on the scan-board five sessions earlier than he did on the tabletop. Participant Danny acquired his sight-word three sessions earlier on the tabletop than he did on the scan-board. Each participant yielded a different result in terms of the stimulus presentation that led to the most rapid acquisition of sight words.

Discussion

This study yielded individual results for each participant. Although a consistent trend of acquisition did not emerge across participants with different stimulus presentations, these findings suggest that each individual learns
differently. In teaching environments, if the teacher or experimenter notices that the acquisition rate of an individual is low in one stimulus presentation, manipulating the stimulus presentation differently for the individual may be beneficial. Varying stimulus presentation may also help decrease off-task behavior. For those students with poor on-task behavior manipulating the stimulus presentation directly at eye level instead of out of direct sight may show an increase in acquisition rates.

There are several limitations in this study that should be considered. During baseline sessions there was no procedural integrity taken to ensure the fidelity of the teaching procedure. Although the baseline rates were below 80% accuracy for each participant, if procedural integrity had been taken during baseline sessions the experimenter could have ensured that there was no prior learning history of the sight-words chosen. This remains especially true for participant Charlie who met mastery criteria after only 18 sessions in both the scan-board and tabletop presentations. In further research, it is recommended that procedural integrity data be collected in all of the baseline sessions.

Another limitation to this study was that the time that passed between training sessions was not held consistent across participants. Danny and Charlie participated in sessions almost everyday, whereas Jimmy, in a different classroom, had a larger gap in time between teaching sessions. The lack of consistent exposure to these sight-words for Jimmy may have effected the number of sessions it took him to meet mastery of the sight words. Of the three participants, Jimmy took the longest to meet mastery of sight words, in both the tabletop and the scan-board
sessions. The confounding variable of the gap between teaching sessions may or may not have led to the higher number of teaching sessions that were required for Jimmy to meet mastery criteria.

Although this study does not result in a specific learning trend, it does open the door for further research in the area of stimulus presentation. Other variables that may be investigated to include the number of stimuli in the array presented to the learner, or the size of the scan-board. Running the discrete trials in a larger array may yield very different results. Also, the scan-board used in this study held the dimensions of 10x5 inches. There is a question of whether a bigger scan-board may have helped the participants attend to the stimuli that was placed on the board. Further research could be utilized in varying the size of the scan-board in an effort to see if acquisition rates increase with a bigger board. Especially considering that each teaching session in this study took place in the classroom, it would be beneficial to know if environmental distracters decrease as the size of the scan-board increases.

Despite the limitations involved in this study, the results suggest stimulus presentation does remain individualized. Students with developmental disabilities may acquire skills faster in one stimulus presentation than another. Therefore, it may be important to try a variety of different stimulus presentations in an effort to find what leads to the most efficient skill acquisition for a particular student. Further research should continue to investigate what variations of stimulus presentations are the most beneficial to teaching a variety of skills in the discrete trail format.
References:


Figure Captions

Figure 1: Jimmy's acquisition of the sight word, “enter,” presented on the scan-board

Figure 2: Jimmy's acquisition of the sight word, “hazard,” presented on the table-top

Figure 3: Charlie’s acquisition of the sight word, “danger,” presented on the scan-board

Figure 4: Charlie’s acquisition of the sight word, “danger,” presented on the table-top

Figure 5: Danny’s acquisition of the sight word, “caution,” presented on the scan-board

Figure 6: Danny’s acquisition of the sight word, “enter,” presented on the table-top
STIMULUS PRESENTATION

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[Graph showing percent accuracy over sessions for Jimmy, with phases labeled 1.1, 1.2, 1.3, 1.4, and follow-up.]