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Running Head: EQUIVALENCE TECHNOLOGY HEARING IMPAIRED

The Use of Stimulus Equivalence Technology to Teach Reading and Reading
Comprehension to a Hearing Impaired Student

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Abstract

Equivalence technology has been very successful in teaching severely mentally retard individuals, as well as typically developed children to read, spell, learn money concepts, and other basic rudimentary skills. Equivalence is a method for forming stimulus classes. For a group of stimulus relations to be equivalent they must be reflexive, symmetric, and transitive. Once a group of stimulus relations past all of the fore mentioned tests they are tested for equivalence. After they passes the test for equivalence then they are considered to be an equivalent stimulus class.

Using equivalence technology I will teach a hearing-impaired student to read, and show reading comprehension. There will be two sets of three words in each set. The words have been matched with their corresponding picture and sign. After preliminary tests the student will be taught the to express the sign (D) when given the written word (B) and the corresponding picture (C) (see figure 1). He will also be taught to select the picture (C) and the written word (B) when given the sign (A). The final equivalence test will be the BC relation. This will show that without the use a verbal behavior equivalence classes will be formed.

The Use of Stimulus Equivalence Technology to Teach Reading and Reading
Comprehension to a Hearing Impaired Student

Equivalence technology is the forming of stimulus classes through the use of standard conditional-discriminations, often called arbitrary or symbolic matching to sample. Participants are presented with a sample and an array of comparisons. The sample or the comparisons could be audio or visual stimuli. When the correct comparison is selected then the participant is said to have selected the comparisons conditionally upon the sample that was given (Sidman, 1992). Through standard conditional-discrimination researchers have been able to teach basic rudimentary skills to animals and people who are typical developed, as well as people with severe mental retardation (Sidman, 1971, Sidman & Cresson, 1973, Mackay 1985).

Sidman (1971) is the pioneering study on the development and proposed use of stimulus equivalence with people with severe mental retardation. Figure 2 shows the basic stimulus equivalence paradigm that was used by Sidman (1971 in Mackay, 1985). In figure 1, there are four types of stimuli; A is the dictated name of the picture, B is the actual picture, C is the printed name of the picture, and D is the oral naming of the item by the student. The solid lines show the relations that are taught by the teacher. These relations are the AB, AC and the BD relation. Upon teaching these relations a number of tests are required to show that emergent relations and stimulus equivalences have been formed.

Stromer et al. (1992) investigated the classroom applications of the equivalence

technology. They suggested that equivalence technology could have two functions in the classroom first as an assessment tool and also as a supplement to the current academic curriculum. They looked at the use of equivalence for rudimentary language arts, such as reading, reading comprehension, and spelling.

Using this model Stromer et al. (1992) suggest that students that have had difficulty learning could benefit and learn how to read and spell using the equivalence technology. They also suggest that equivalence can also be used in a group situation and will help a teacher to determine if there is a gap in skills and that is why the student is not making adequate progress with a skill'

Even though there are have been many articles published about the benefits of stimulus equivalence as a teaching method and as an assessment method, there have been some opponents. Horne and Lowe (1996) published an article on the role of naming in the formation of stimulus classes. They stated that the ability to acquire naming and have that in ones repertoire in itself brings about emergent relations. They state that since equivalence has not been shown to occur in nonverbal animals, then the ability to name is the higher process that allows emergent relations, not stimulus equivalence.

The relational frame theory of verbal behavior looks at the formation of stimulus classes as a stimulus-response situation, instead of a stimulus-stimulus situation like Sidman does. In Hayes, Fox, Gifford, Wilson, Barnes-Holmes, and Healy (2001) they state that the formations of stimulus classes are a learned behavior and that verbal events are activities and not products. This focuses on the interactive nature of behavior events. Therefore emergent behavior occurs based on the past operant histories of the students.

In 1986, Devany, Hayes, and Nelson looked at the use of stimulus equivalence in

language-able and language-disabled children. They hypothesized that children who were not language-able would not be able to form stimulus classes. They found this to be true. Barnes, McCullagh, and Keenan (1990) took their study a step further and looked at hearing impaired children vs. non-hearing impaired children to see if there was a difference between the two groups in forming equivalence classes. They found that only one of the hearing-impaired children was not able to form equivalence classes. The participant that was not able to form equivalence classes also had a verbal age lower than two years. They concluded that stimulus equivalence and human verbal behavior are closely related and that people with a verbal age equivalents that is higher than age two can form equivalence classes, even if they are hearing-impaired.

This research will use the principles of equivalence technology that have been laid out in the Stromer et al. (1992) article on classroom use of stimulus equivalence. This research will test the use of stimulus equivalence technology as a method for increasing the vocabulary and reading comprehension in a student who is hearing-impaired and has developmental and social delays. The importance of this research is to show that equivalence can be adapted without the use of auditory stimuli and only the use of visual stimuli and American Sign Language (ASL).

Method

Participant

J.S. is a fourteen-year-old boy with developmental and social delays and is hearing impairment. He also has significant emotional and behavioral issues. J.S. has had a successful history with reading and writing, but is functioning several grades below grade level and not acquiring new vocabulary as fast as other hearing impaired students.

Setting

Substantially separate classroom in an urban public school. The classroom is for students with dual diagnoses.

Interobserver Agreement

Interobserver Agreement (IOA) was taken for 25% of the trials, by an independent observer. IOA was taken on participants responses, as well as if the teaching procedure was being implemented correctly and reinforcement given correctly. IOA was calculated for accuracy of data collection by taking the number of trials correct minus the number of trials incorrect divided by the total number of trials multiplied by 100. IOA was 100% through out the study.

Procedural intergrty was calculated by

Dependent Variables

Reading: Pointing to the correct word when given the corresponding sign, as well as giving the correct sign when shown a printed word.

Reading Comprehension: Pointing to the correct picture when given the corresponding printed word and vice versa.

Experimental Design

A variation of a multiple probe design was utilized when testing for emergent relations.

Teaching Method

The teaching method that was utilized during the pre-training and the teaching phases of the study is a delayed cue procedure. The delayed cue was on a 0 second delay and increased in increments of 1 second for each session. The criterion for increase is the

exhibiting of correct responding for at least 80% of all the trials of the session, prompted or unprompted.

Reinforcement

Reinforcement was introduced during phase 2. The participant was able to earn a penny for correct responding on a FR1 schedule, which was thinned to a VR3 schedule that was used through out the additional phases, except for the test for emergence and the assessment phases.

Money was collected at the end of each session and the participant put it in a container. At the completion of daily sessions for each day sessions the student was allowed to count his money. If he had enough money at the end of the day for something in the vending machine he was allowed to access the vending machine. If he did not have enough money for something from the vending machine he was able to put it back in the container for the next days session. The student always wanted to get access to the vending machine when he had enough money. Money was not allowed to be taken home. It had to be used in the school vending machine or put back in the container for the next day. He was allowed to take his item that he purchased from the vending machine home with him.

Phase 1-Pre-Testing

Established a set of maintenance words that could be read by the participant and a set of acquisition words that could not be read by the students. This was done by holding up a card with a printed word on it. The words were only probed one time. Once a set of acquisition words was established the corresponding pictures were tested. From these probes a set of acquisition stimuli (printed word and picture) was established. There was

six words selected that were broken up into two sets of three. A set of three maintenance words were also matched with a picture to be used during the pre-training and teaching phases.

Phase 2-Pre-Training

The maintenance word sets were used in pre-training to determine if the participant understands what is expected of him for each task. The tasks that were tested were picture-to-picture identity matching, printed word to printed word identity matching, pointing to a picture of a printed word or picture when given the corresponding spoken word, and expressing a sign when shown a picture or a printed word. Once the participant showed fluency for three trials of each task he was able to move on to the next phase of the study.

Phase 3-Assessment

All acquisition stimuli, 2 groups of three printed words and their corresponding picture, was assessed for each stimulus relations. Acquisition stimuli were picked based on, (1) unknown word and picture, (2) the word has a definitive sign, and (3) the word could be matched up with a picture. Figure 1 show the stimulus equivalence paradigm that was utilized for this study. A was the sign from the instructor to the participant, B was the printed word, and C was the corresponding picture. Letter D represented expressive sign from the participant. The AB and AC relations were assessed first. Then the CB relation was assessed for equivalence. The BD and CD relations were also being assessed before any teaching was started. There was no reinforcement given for trials during the assessment, instead a bulk of 15 pennies was given at the end of the assessment. The participant was notified that he would not be earning pennies for each

trail, but would get pennies at the end for good participation.

Phase 4- Teaching I

The AB relations (given sign-printed word) were taught first. All stimuli were taught using the same procedure. The first group of three was the given sign (A) paragraph, toast, and pump and their corresponding printed word (B). The second set of spoken words that were used was medicine, slice, and stream matched with their corresponding printed word. Teaching was done using the previously explained delayed cue procedure and reinforcement was given on the VR3 schedule. Accuracy and Independence was measured during this phase and subsequent phases. Presentation of each stimulus was counter balanced before each session. There was eighteen trials in each session, so each stimulus pair was presented six times in each session. Teaching was continued, until all pairs were mastered, thus the AB relation was shown for all stimuli. There was an assessment (same as phase 2) after each set of three is mastered.

The AC relation (given sign-picture) was taught next. It was taught in the same manner as the AB relation was taught, using two sets of maintenance stimuli for the first set. An assessment was conducted as well when the AB relation was mastered. Once all 3 sets of stimuli were taught and both the AB and AC relations were expressed by the participant for all of the stimuli, we conducted the equivalence (CB) test. Reinforcement during the teaching 1 phase was on a VR3 schedule for correct independent responding.

Phase 5- Equivalence Test I

The CB relation was tested during this phase. Set 1 B was the printed word paragraph, toast, and pump and the C was the corresponding picture for each printed word. The relations were probed during this phase. The probe trials were mixed with

maintenance trials the same as during the assessment phases. After mastery of set 1, set 2 was probed mixed with maintenance stimuli. This occurred during the second session. This was continued until all of the stimuli had been probed. If emergent relations did not emerge for some stimuli then Phase 4 was implement again for those stimuli that did not show emergence (this did not occur during this study). This phase was done under extinction. At the end of the session 15 tokens where given for participating in the session, the same as the assessment phase.

Phase 6- Teaching 2

Next, the BD (printed word-expressive sign) relation was taught. The teaching method, prompting method and reinforcement was the same as phase 4. An assessment was conducted after each set of 3 was mastered. Once the BD relation had been mastered, the CD relation was tested for emergence. This emergence test will be conducted the same as the equivalence test in phase 5. Reinforcement was on a VR3 for the teaching of the BD relation. Reinforcement was put on extinction during the CD probes.

Results

J.S. was able to form stimulus equivalent relations at the end of the study and showed faster rates of learning as the study went on. Figure 3 shows the accuracy rate for set 1 through out each phase of the study. It took seven sessions for J.S. to reach three sessions of 80% accuracy or better for the AB relation. After that J.S. took only one or two sessions to show mastery of the remaining relations. The probes for CB relation for each stimulus were 100% accuract and showed that stimulus equivalence had been achieved.

Progress was much quicker for Set 2. In Figure 4 you can see the percent accuracy for each of the phases. It only took four sessions for J.S. to reach mastery and move on to the next relation. J.S. showed emergence during the CB tests on the first probe session, as well.

J.S. showed learning when he was tested on the BD relation with 100% accuracy and independence for both sets 1 and 2 in the first session. Due to this we moved on to the test of emergence with no reinforcement. J.S. again showed 100% accuracy and independence for both sets 1 and 2 during the probe session for the CD relation.

Discussion

In conclusion we have upheld the findings by Barnes et al (1990). Though J.S.'s verbal age equivalent was not ever calculated it was believed to be higher than 2 years of age. He not only showed equivalence classes and increased his vocabulary and reading comprehension, he was able to do it very efficiently. J.S. showed learning through out the study. In the first couple of sessions of set 1 AB relation J.S. struggled to make correct responses. After the initial seven sessions J.S. showed precision with responding and mostly 100% accuracy and independence for the remainder of the study.

Future studies might look to replicate the Mackay (1985) study and see if hearing-impaired individuals would be able to learn spelling using equivalence technology. We preliminary probed to see if spelling had emerged for the words he had already shown mastery of in the study. Figure 5 shows the proposed extension of the study's original stimulus equivalence paradigm to include finger spelling. J.S. did not show emergence of the AE (spoken word-finger spelling) relation or the CE (Picture-finger spelling) relation. Our next step would be to teach the AE relation and then probe for emergence of the CE

relation.

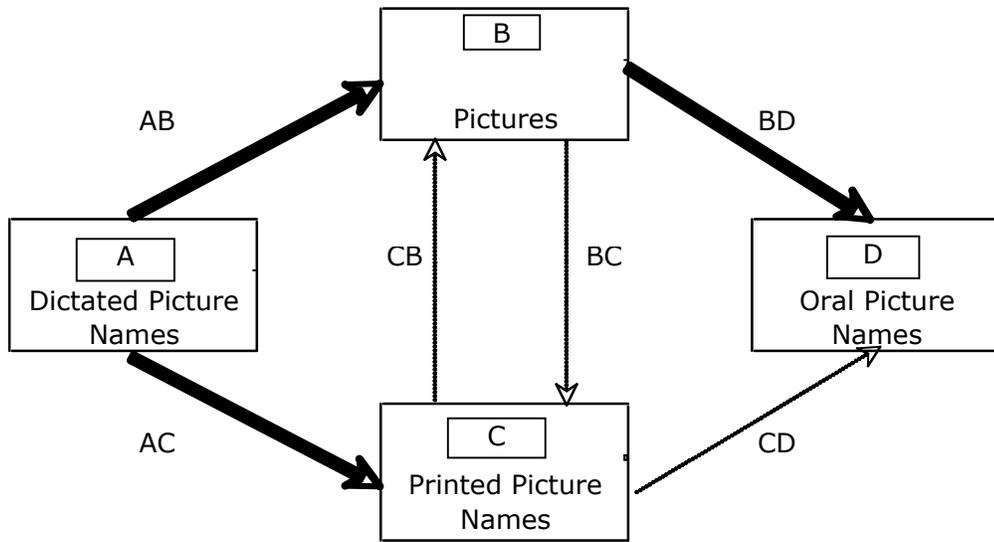


Figure 1. Show the stimulus equivalence paradigm being utilized during this study.

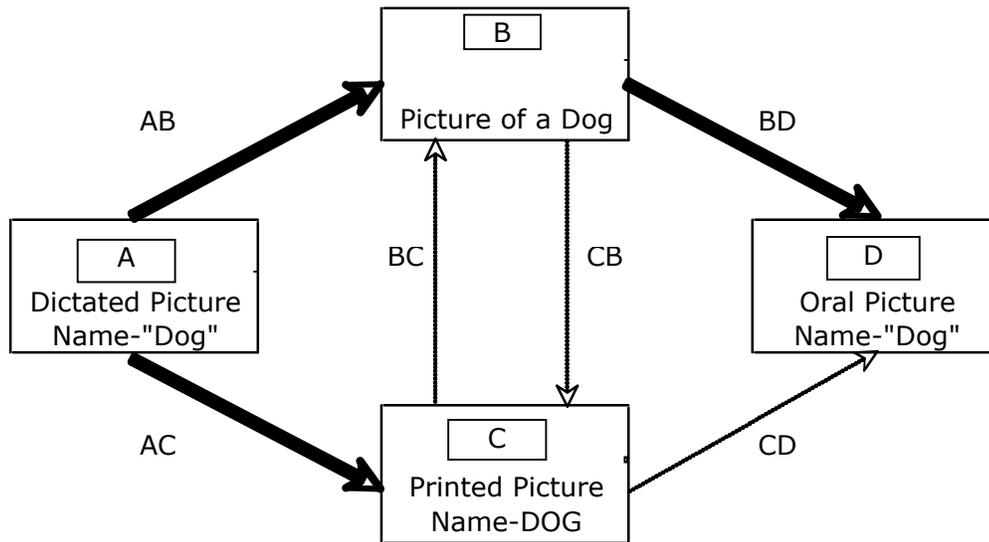


Figure 2. Show the stimulus equivalence paradigm first used by Sidman (1971). The word Dog is being taught to eh student using the stimulus equivalence paradigm.

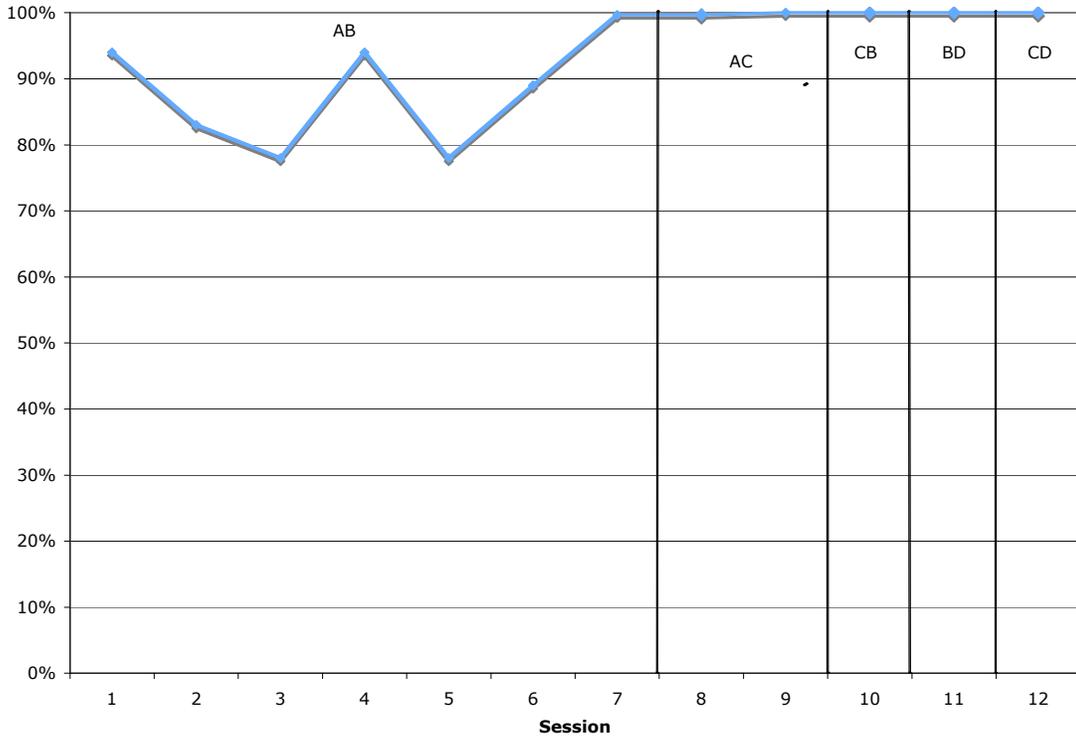


Figure 3: The percent accuracy for each session for set 1. Phase change lines indicate the different relations tested.

Equivalence Technology 16

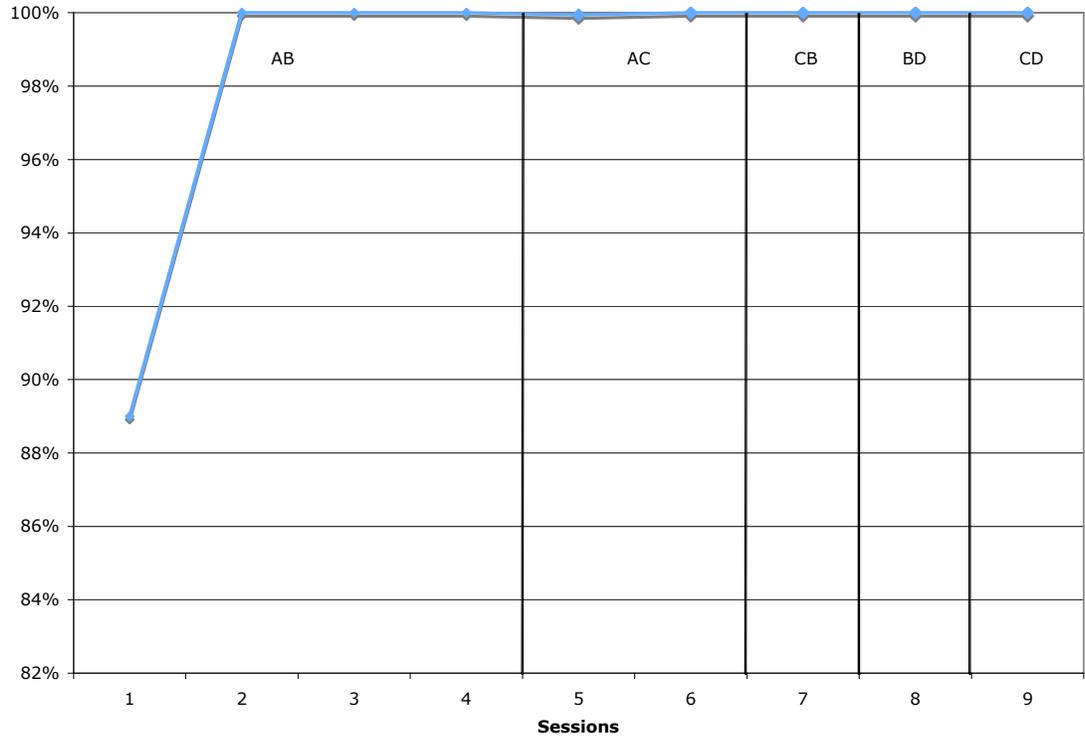


Figure 4: The percent accuracy for each phase for set 2. Phase change lines are used to show the different relations tested.

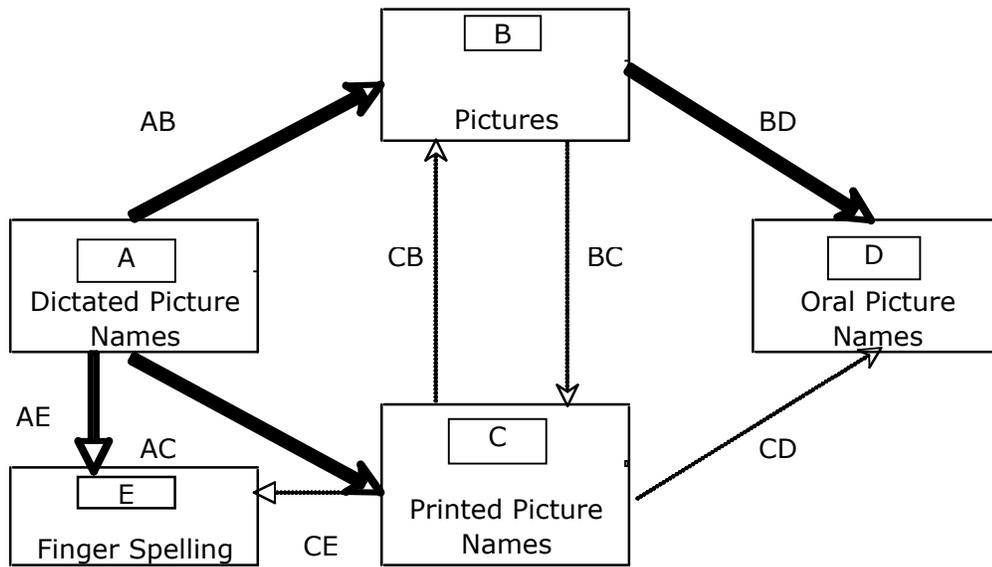


Figure 5. Show the proposed extension of the stimulus equivalence paradigm to include spelling.

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