

## **The Effects of a Stimulus-Stimulus Pairing Procedure on the Acquisition of Conditioned Reinforcement on Observing and Manipulating Stimuli by Young Children with Autism**

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### Abstract

In 2 multiple baseline experiments, we tested stimulus-stimulus pairing effects on acquisition of conditioned reinforcement for observing and manipulating stimuli and stereotypy/passivity. In Experiment 1 we studied a 5 year-old male with autism and we collected data using continuous 5-sec whole interval recording in 5 min sessions in which the student emitted appropriate play, and partial intervals of stereotypy, or passivity. Experiment 2 tested the effects of same procedure on independent work by 2 male participants with autism. The dependent variables were: intervals in which students worked independently, percentage of correct responses, and worksheet completion. Results from both experiments showed significant increases in numbers of intervals students emitted the target behaviors and decreases in stereotypy and passivity.

Key words: stimulus-stimulus pairing procedure, conditioned reinforcement, observing responses, preference

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Conditioned reinforcers are defined as initially neutral stimuli that have acquired reinforcing characteristics through the pairing of the neutral stimuli with a previously conditioned or unconditioned reinforcer (Cooper, Heron, Heward, 1988). For many students with disabilities, pairing procedures are necessary to condition stimuli that are important for development and academic progress. Dinsmoor (1985) found that greater observing or attending to specific stimuli (the reinforcement for observing are the stimuli) resulted in an increase in stimulus control for components of those stimuli.

Sundberg, Michael, Partington, & Sundberg (1996) developed a stimulus-stimulus pairing procedure to condition vocal sounds as reinforcers for students who had a limited vocal verbal repertoire. Vocal repertoires were observed and analyzed during pre- and post-session observations across experimental conditions. One of the conditions was a stimulus-stimulus pairing condition, in which target sounds, words, or phrases was paired with a previously conditioned reinforcer. Results from the first experiment showed that all participants emitted the target sounds in the post-pairing condition. The results showed that children acquired new vocal responses without direct reinforcement, echoic training, or prompts. In the second experiment, the parameters of the pairing procedure were analyzed. Other studies ( Yoon & Bennett, 2000; Miguel, Carr, & Michael, 2002) have replicated the findings by Sundberg et al. showing the effectiveness of the stimulus-stimulus pairing procedure of the acquisition of vocal verbal behavior, also known as parroting. Yoon (1998) found that once parroting was acquired through the stimulus-stimulus pairing procedures, those acquired sounds can then be used to begin instruction for functional speaker behavior. After students acquired vocal sounds, as a result of the pairing procedure, mand instruction was implemented using those sounds using an echoic to mand procedure developed by Williams and Greer (1993).

Stimulus-stimulus pairing procedures have also been used to expand children's community of reinforcers by teaching them to prefer previously non-preferred stimuli (Greer,

Becker, Saxe, & Mirabella, 1985; Greer, Dorow, & Hanser, 1973; Nuzzolo-Gomez, Leonard, Ortiz, Rivera, & Greer, 2002). In the studies by Greer et al. and Nuzzolo-Gomez et al. a conditioning procedure was used to teach student to select books or toys as a preferred activity. This procedure also functioned to replace stereotypy with the reinforcement effects of observing books. As a result of the conditioning procedure, the students engaged in appropriate toy play or looking at books during their free time instead of emitting stereotypy. Furthermore, results showed that the conditioning procedure was an effective tactic to teach the student to play or look at books appropriately and independently.

More recently, Tsai & Greer (see this issue of JEIBI) conducted a study to investigate the effects of the conditioning procedure on textual responding. Pre- and post-conditioning probes were conducted on the numbers of correct responses for textual responding to sight words. Also, a pre- and post-conditioning probe was conducted to determine if books functioned as a reinforcer for the participants in the study. Pairing training and test trial conditioning procedure was used to condition books as a reinforcer after the pre-conditioning probes. Following the completion of the conditioning procedure, probes were again conducted on the numbers of correct responses for textual responding. Findings showed a decrease in numbers of learn units required to master textual response, and maintenance of the reinforcement effects for observing books for three of the four children.

The purpose of studies reported herein was to test the applicability of the stimulus-stimulus pairing procedure on independent play and independent responding to worksheets during seatwork. In the first study, the pairing procedure was implemented due to the low levels of appropriate play and high levels of stereotypy emitted by a student. The stimulus-stimulus reinforcement pairing procedure was implemented to condition toys as reinforcers for play, computers as reinforcers for manipulation, and books as reinforcers for observing and to test the effects of this conditioning on levels of stereotypy. In the second study, the conditioning procedure was implemented to condition worksheets as reinforcers for responding to the worksheets and the numbers of correct responses to worksheet skills before and after the stimulus-stimulus pairing procedure.

### Experiment 1

#### Method

##### *Participants*

One student participated in the first experiment. Student A was a 5-year-old boy who was diagnosed with autism. The student was assessed using the PIRK (Greer & McCorkle, 2003). Results for the assessment showed the student was functioning on a speaker and emergent reader/writer level of verbal behavior. Table 1 shows the participant’s capabilities, programs of instruction, and behaviors in the student’s repertoire.

Table 1: Characteristics of Student A

Age/ Gender	Standardized Assessment and Diagnosis	Academic Behaviors
* Male *5 years old	* Learning Accomplishment Profile - Matching: AE 36 mos. - Counting: AE 35 mos.	*Generalize Matching and Pointing repertoire  * Speaker repertoire includes

	<p>- Writing: AE 54 mos.</p> <p>*Overall cognitive functioning falls within the low average to below average range.</p> <p>* Diagnosis of autism</p>	<p>tacts and mands with autoclitics, some sequelics, and limited conversational units.</p> <p>* Emergent reader/writer repertoires</p>
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The student was selected for this study based on the high levels of stereotypy and low levels of appropriate play in free time when he was using the computer, playing with toys, and looking at books. The student frequently manded to use the computer, which indicated the computer functioned as a conditioned reinforcer for the student prior to the onset of the study. However, the student also had an instructional history in which stereotypy (hand-flapping) was a concomitant response with using the computer. The student frequently requested to earn to free time in the activity center. When in the activity center, the student emitted stereotypy or passivity instead of appropriately playing with toys and other materials in the activity center. Often, the student used toys as part of his stereotypy.

*Settings*

The study took place in a CABAS® classroom (Greer, 1996) located outside of a major metropolitan area. The classroom ratio consisted of five students, 2 teaching assistants and one teacher. For toy play and looking at books, baseline conditions consisted of the student sitting or standing in the activity center. When probes were conducted for toys, toys were placed on the carpet in the activity center. For baseline probes for looking at books, books were placed on the carpet of the activity center. The activity center contained a computer, stuffed animals, and shelves filled with toys and board games. The activity center was located in one of the corners of the classroom. During the intervention phase, the student sat at a rectangular table where instruction was presented. The experimenter sat next to the student during the implementation of the stimulus/stimulus pairing procedure. During baseline probes for playing on the computer, Student A sat at the computer while the experimenter sat at least 5 feet away. The materials used in this study consisted of the toys, board games, books, and the computer. The computer used in was located in one of the corners of the classroom near the teacher’s desk. During the study, other students in the classroom were presented with instruction in 1:1 or small group settings. Other materials used included a timer, pen, graphs and data forms.

*Definitions of Behavior*

The dependent variables in this study included appropriate play on the computer and with toys, looking at books, stereotypy, and passivity. For Student A, the behaviors observed during pre and post-conditioning probes consisted of appropriately playing at the computer, stereotypy, and passivity. Appropriately playing with toys included the student holding a toy in his hand while making movements representing symbolic play (rolling a car on a floor),and/or talking to the toy or talking about the toy. Appropriately playing at the computer was defined as sitting on a chair by the computer, looking at the computer screen, typing on the key board or operating the mouse, or interacting with the computer game (reading along with the story, laughing, or describing the pictures on the screen). Looking at books was defined as pointing to pictures in the book, describing the pictures in the book, or simply looking at the book. Stereotypy was defined as “cycles of repetitive movements that have no apparent consequences for the individual who is emitting the response beyond the movement itself.” (Greer et al.. 1985) In the case of the

present study, the student's stereotypy consisted of hand flapping or flapping with objects in his hand.

#### *Data Collection*

During pre and post conditioning probes, data were recorded using whole interval recording. Each probe session was conducted for 5 minutes, and data were recorded for 60 continuous 5-sec intervals. If the student emitted the target behavior for the entire five-second interval, a plus (+) was recorded. Partial interval recording was used to mark instances of stereotypy and passivity. Therefore, an (S) was recorded if the student emitted stereotypy at any point in the five second interval. If the student emitted passivity at any point of the five second interval, a (P) was recorded.

There were 20 train-test trials in the stimulus-stimulus pairing procedure. Each training trial was a stimulus-stimulus pair followed by a test trial. To begin, the experimenters set a timer for the specified interval time. Then the experimenters conducted the stimulus-stimulus pairing trial. In the stimulus-stimulus component of the train and test trials the child was required to emit the target behaviors with no occurrences of stereotypy. If stereotypy occurred in this component, the train trial was begun again. In other words the child had to complete a stimulus-stimulus pairing trial with no stereotypy and he had to emit the target behavior for the entire pairing period. After the training trial was complete, the test trial began. Data were collected on the presence or absence of the target behavior for each test interval. A plus (+) was recorded if the student came into contact with the target item for the whole interval. A minus (-) was recorded if the student emitted stereotypy, passivity, or any other incompatible behavior at any moment of the test interval. One session of the stimulus/stimulus pairing procedure consisted of the completion of 20 train and test trials. Following each session, data were graphed as the number of intervals the student emitted the behavior out of 20 opportunities. Graphs were analyzed using the CABAS® decision tree protocol (Greer, 2001). Criterion was set at 18/20 correct test trials or better for two consecutive sessions.

#### *Design*

A multiple baseline across behaviors was used to test the effects of the stimulus/stimulus pairing procedure. Pre-conditioning sessions were conducted. After stable levels of appropriate play for the first behavior, toy play, were observed, the stimulus/stimulus pairing procedure was implemented. Baseline sessions were continued for computer and books. Once effects of the stimulus/stimulus pairing procedure were observed for the first behavior, the procedure was implemented for the second behavior, appropriately playing on the computer. Baseline probes were continued for looking at books until stable responding was recorded and until effects of the stimulus/stimulus pairing procedure was observed for playing on the computer. Following the student achieving criterion, a post-stimulus/stimulus pairing probe was conducted. Post- probes were conducted until the student maximum effects were observed. Table 2 shows the sequence of phases in Experiment 1.

Table 2: Design Sequence

Phase	Description
1. Baseline probe sessions  * 5 sessions for toy play * 6 sessions for computer * 8 session for looking at books	*60 five second intervals (5 min) *Whole interval recording for appropriate behavior * Data were collected on appropriate behavior, stereotypy, and passivity * Consequences were not delivered
2. Implementation of stimulus-stimulus pairing procedure 5 sec intervals	*Pair/test trial * Pairing trial- Reinforcement (praise) is delivered 2 or 3 times during pairing session. * Test trial- Experimenter observed student for 5 sec. A (+) was recorded if student emitted behavior for 5 sec, and a (-) was recorded if student did not. Consequences are not delivered following the test trial * Criteria: 18/20 test trials or better for two consecutive sessions. Once students achieved criteria the next phase was implemented.
3. One session probe	* Same as baseline probes
4. Implementation of stimulus-stimulus pairing procedure 10 sec intervals	* Same as pair/test trial described above
5. One session probe	* Same as baseline probes
6. Implementation of stimulus-stimulus pairing procedure 15 sec intervals	* Same as pair/test trial described above
7. One session probe	* Same as baseline probes

*Conditioning Procedure*

The independent variable was the stimulus/stimulus pairing procedure, which was derived from a previously tested protocol (Greer et al., 1985; Nuzzolo-Gomez et al., 2002; Tsai & Greer, 2006). The stimulus/stimulus pairing procedure consisted of alternating between training trial and a test trial. A session was completed after 20 test trials were observed. To begin, both training and test trials were implemented for 5 sec. First, the experimenters conducted the training trial, in which the experimenters paired a conditioned reinforcer, most often in the form of vocal praise, with the student emitting the target behavior throughout the entire interval and no stereotypy. During the training or pairing trials, the experimenters delivered vocal praise 2 or 3 times in the specified interval. The experimenters alternated between 2 or 3 pairings of reinforcement so that reinforcement pairing was delivered on a variable schedule. A training trial was complete if and only if the student emitted the target behavior for the whole interval. If at any time during the training trial the student emitted any other behavior than the target behavior, the experimenters reset the timer and restarted the training trial. Once the student emitted the target behavior for the whole trial, the experimenters then observed the student during the test trial. The test trials consisted of the experimenter starting the timer for the specified time of the interval and observing the child. During the test trial, no pairings were presented. The presence or absence of the target behavior was observed during the test trials. Immediately following the test trial, the

training trial was again implemented. No instruction in the form of learn units was presented during the conditioning procedure, and therefore no corrections were presented contingent upon incorrect responses and reinforcement was only delivered during the training trial. Reinforcement was not delivered following the test trial. After the student met criterion, emitting the target behavior for 18/20 or more test trials for two consecutive sessions, a post-conditioning probe was conducted. If data collected during the probe session indicated that the target item did not function as a reinforcer, the conditioning procedure was again implemented. However, upon each implementation of the pairing procedure, the intervals were increased in 5 sec increments but the same number of 2 or 3 pairings occurred in the training trial component of the train and test trials.

#### *Interobserver Agreement*

During probe sessions, interobserver agreement measurement was recorded by a second and independent observer taking data simultaneously with the experimenter. The percentage of interobserver agreement was calculated on an interval-by-interval basis by dividing the number of agreements by the total number of agreements and disagreements and multiplying this number by 100%. During pre/post probes across behaviors, interobserver agreement was conducted for 12% of the sessions, in which 100% agreement was recorded.

#### Results

Figure 1 shows the numbers of intervals Student A emitted appropriate and independent play or looking at books, and the numbers of intervals in which the student emitted stereotypy or passivity across behaviors. For toy play, the mean numbers of intervals in which the student emitted appropriate toy play was 12.2 (range: 4 to 21), stereotypy was 37 (range: 31 to 45), and passivity 10.6 (range: 4-19). Following the completion of the 5 sec training/test trial stimulus-stimulus pairing, a post-probe was conducted. The student emitted appropriate toy play for 49 intervals, emitted stereotypy for 6 intervals, and passivity for 5 intervals. The stimulus-stimulus pairing procedure was again implemented. This time, 10 sec. training/test trials were used. A post-probed showed an increase in the numbers of intervals in which the student emitted appropriate toy play, 58 intervals, and a decrease in the numbers of intervals in which the student emitted stereotypy and passivity, 2 and 0 intervals respectively.

FIGURE 1, NEXT PAGE

FIGURE 1, NEXT PAGE

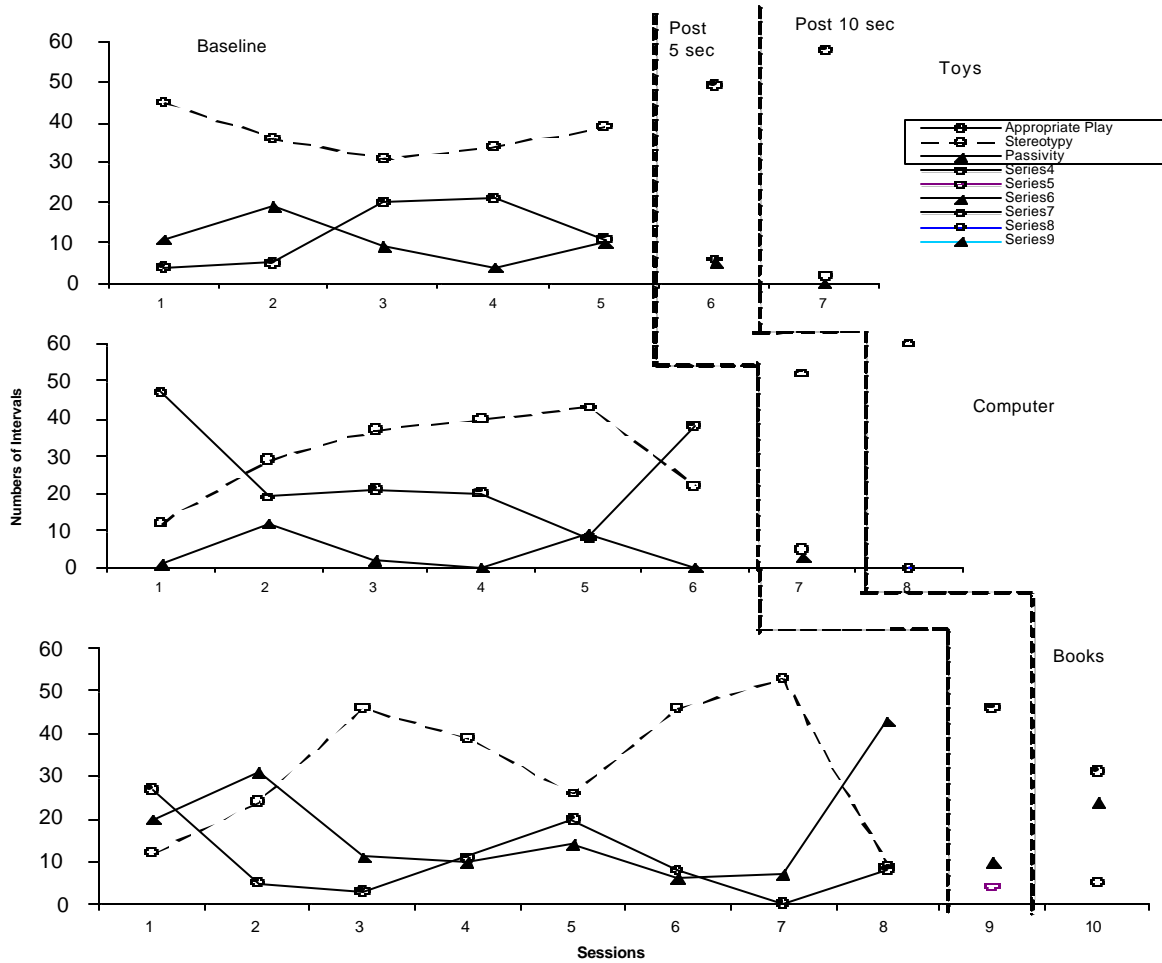


Figure 1. The graph shows a multiple baseline across behaviors design for Student A. Results from pre-pairing baseline probes are shown along with post-pairing probe sessions.

During baseline, the mean number of intervals in which appropriate computer play was recorded was 25 (range: 8-45), the mean number of intervals in which stereotypy was recorded was 30.5 (range: 12-43), and the mean number of intervals in which passivity was recorded was 4 (range: 0-12). Following baseline, the stimulus-stimulus pairing procedure was implemented for 5 sec training/test trials. After the student met criterion, 18/20 tests trials or better for two consecutive sessions, a post-conditioning probe was conducted. During this probe, the student emitted appropriate computer play for 52 intervals, stereotypy for 5 intervals, and passivity for 3 intervals. The stimulus-stimulus pairing procedure was implemented for 10 sec. training/test trials. After the student achieved criterion for this phase, a post-conditioning probe was conducted. After the 10 sec. training/test trial phase, the student emitted 60 intervals of appropriate computer play during the post-stimulus-stimulus pairing probe and no instances of passivity or stereotypy.

For looking at books, data were recorded for 8 sessions under free play baseline conditions. The mean numbers of intervals the student emitted appropriate looking at books was 10.25 (range: 0 to 27), stereotypy was 31.75 (range: 9 to 53), and passivity for a mean of 17.88

intervals (range: 6 to 43). Post 5 sec. training/test trial, the student emitted 46 intervals of looking at books, 4 intervals of stereotypy, and 10 intervals of passivity. Following the probe, the stimulus-stimulus pairing procedure was implemented for 10 sec pairing/test trials. After the completion of this phase, a post-probe was conducted, in which the student emitted 31 intervals of looking at books, 5 intervals of stereotypy, and 24 intervals of passivity.

Data were also collected during the stimulus-stimulus pairing procedure, which is represented in Figure 2. Student A met criterion after seven sessions of the 5 sec. training/test trials. Test intervals of appropriate play ranged from 16-20 during this phase. Student A met criterion for 10 sec. training/test trials after three sessions. Test intervals of appropriate play ranged from 17-20.

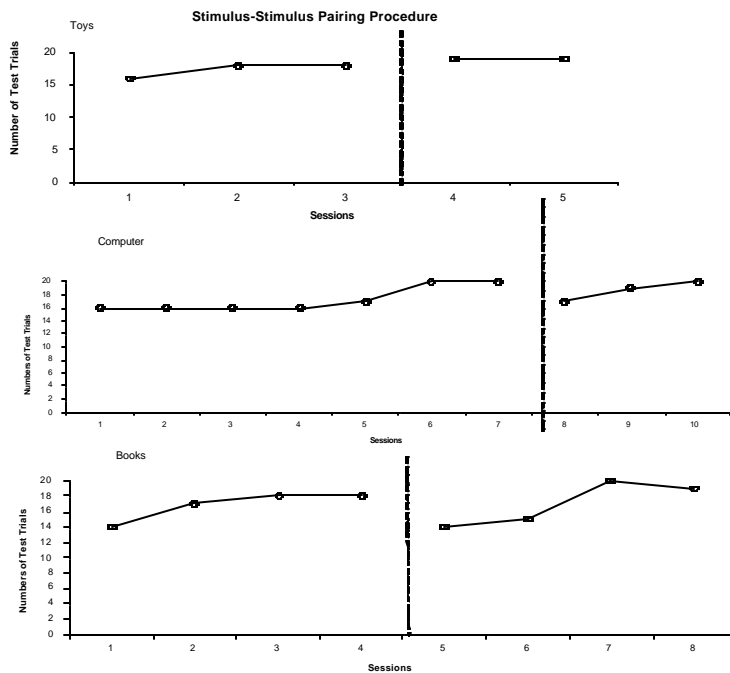


Figure 2. The figure shows the numbers of intervals out of a 20-test interval session in which Student A emitted appropriate behavior during the implementation of the stimulus-stimulus pairing procedure.

### Discussion

An increase in appropriate and independent play was observed across three behaviors, playing with toys, playing on the computer, and looking at books. The stimulus-stimulus pairing procedure was effective in increasing appropriate play while decreasing stereotypy and passivity. For the third behavior, looking at books, in the second post probe, a decrease in the number of intervals in which the student appropriately looked at books decreased from the first post-probe, and an increase in passivity were observed. However, stereotypy occurred at low levels. These findings extended and replicated the findings from previous studies (Greer, Dorow, & Hanser, 1973; Greer, Becker, Saxe, & Mirabella, 1985; Nuzzolo-Gomez, Leonard, Ortiz, Rivera, & Greer, 2002). In an expansion of the findings from the present study and the studies listed above, Tsai and Greer (in press.) found that conditioning book stimuli through a similar stimulus-stimulus pairing procedure lead to accelerated learning of textual responses. As a result, the following experimental question arose; would the conditioning of stimuli associated with independent



seatwork, such as worksheets, increase the production of correct responses and increase the intervals in which the students independently emitted seatwork activities. Experiment 2 was designed to test the possibility.

Experiment 2

Method

*Participants*

Two students participated in the second study. Student B was a 7-year-old boy also diagnosed with autism. After being assessed using the PIRK (Greer & McCorkle, 2003), the student was functioning on an emergent reader/writer level of verbal behavior. The student frequently emitted conversational units with peers and adults. General classroom instruction was most often delivered in a 1:1 setting and focused on increasing the student’s reader, writer, and speaker, and social repertoires. The student was selected for this study because he had the prerequisite skills (following an activity schedule, staying in the activity center for 10 minutes, and emergent writer behaviors) for independent work. However, before worksheets were given to the student, baseline data indicated the student emitted low frequencies of working independently with worksheets and high frequencies of off-task behavior (passivity, talking to others, playing with materials, or stereotypy). Worksheets did not function as reinforcers during independent seatwork for Student B.

Student C was a 6-year-old boy diagnosed with autism. He functioned on an emergent reader/writer level of behavior, as indicated by the PIRK assessment (Greer & McCorkle, 2003). The student frequently emitted conversational units with peer and adults. General classroom instruction was mostly delivered in a 1:1 setting or in a small group setting. The student did not work independently. The student was selected for this study because he had the prerequisite skills for working independently. However, when given worksheets or other activities the student emitted low levels of working independently and high levels of off-task behavior (passivity or stereotypy). Therefore, the stimulus-stimulus pairing procedure was implemented to test the effects on independent seatwork. Because worksheets did not function as a reinforcer for responding, the student chose not to complete the worksheets, but rather, emitted passivity or stereotypy. As a result, the student was a candidate for this study.

Table 3: Characteristics of Student B and C

Student/Gender/Age	Standardized Assessment & Diagnosis	Academic Behaviors
* Student B * Male * 7 years old	* Wechsler Preschool & Primary Scales of Intelligence III: Raw Score on full scale was 54 * Woodcock-Johnston III ACH Tests: Grade Level across academic areas- Kindergarten level * Student suffered oxygen deprivation at birth and has significant delays in all academic readiness skills.	*Generalize Matching and Pointing repertoire * Speaker repertoire includes tacts and mands with autoclitics, some sequels, and limited conversational units. * Emergent reader/writer repertoires

	* Diagnosis of autism	
* Student C * Male * 6 years old	*Standardized assessments were not updated at time of study, and therefore did not accurately represent the student’s ability levels.  *Diagnosis of autism	* Speaker repertoire includes tacts and mands with autoclitics, some sequels, and limited conversational units.  * Emergent reader/writer repertoires  * Emergent self-editing repertoire

*Setting*

For Student B and Student C, baseline was conducted at a table. The students were given a folder with several worksheets and the vocal instruction of “Please do your work”. Again, the experimenters sat at least 5 feet away to collect data. During the treatment, the setting for each student remained the same except that the teacher sat either next to the student or across from the student. The materials used for this study included the computer and the variety of software that was programmed into the computer, worksheets (Spectrum Preschool Skills, Beginning Explode the Code, dot to dot, tracing, etc.), timer, writing tools, and data forms. During the study, other students in the classroom received instruction in a 1:1 setting or a small group setting.

*Definition of Behaviors*

For Student B and Student C, the dependent variables were working independently on worksheets, the number of correct responses to learn units (Greer & McDonough, 1999), and completing an activity schedule. Independently working on worksheets was defined as the student using a writing tool to mark on the worksheet or emitting preparation responses to working on the worksheet, which included picking up the writing tool, getting a new worksheet out of his folder, or putting a completed worksheet into his folder. If the student emitted any other behaviors such as putting their writing tool down, talking about other activities or to other people while not completing their worksheets, or sitting and looking at other objects were recorded as the student not independently working. Correct responses to learn units consisted of the students’ responses to specified written directions on worksheets (Greer & McDonough, 1999). Each separate opportunity for the student to provide an answer was measured as one learn unit. The other dependent variable, completing the activity schedule, consisted of the reading the worksheet name to be completed and placing a check mark in the correct box following the completion of that worksheet. The student was required to emit the behaviors described above for each worksheet. For 10 worksheets there were 20 learn unit opportunities on the activity schedule.

*Stimulus-Stimulus Reinforcement Pairing Procedure*

The same procedure that was used in Experiment 1 was used in Experiment 2. However, the objective of implementing the procedure was to condition worksheets as a reinforcer for attending and responding. Worksheets were conditioned as reinforcers as a prerequisite skill to the implementation independent seatwork with worksheets and to increase the numbers of minutes the students engaged in independent work.

*Data Collection*

For pre and post probes session for conditioning worksheets, data were recorded in the similar fashion as in Experiment I with several exceptions. First, each probe session was conducted for 15 minutes, and data were recorded after 1-minute intervals.(continuous 1-min. whole intervals) Therefore, data were recorded for 15 intervals. Whole interval was used to record the presence and absence of the target behavior, independently working on worksheets. If the student emitted the target behavior for the entire minute interval, a plus (+) was recorded. If the student emitted incompatible or behaviors other than the target behavior at any point during the interval, a minus (-) was scored. Permanent products were also used to record data for the completion of the activity schedule, correct responses to learn units (Greer & McDonough, 1999), and the total of completed worksheets during pre and post conditioning probes.

*Design*

In Experiment 2, the conditioning procedure was implemented to condition worksheets as a reinforcer to increase the numbers of minutes the students engaged in independent work. The procedure was implemented in the same sequence for each participant. The steps were as follows: First, pre-conditioning probes were conducted. Next, 20 five-second training/test trial sessions, the stimulus-stimulus pairing procedure, were implemented until student met the criterion. Next, post-conditioning probes were conducted. If the student did not achieve the set objective during the probes, 10-second training/test intervals were implemented to pair a reinforcing stimulus with the target item. Then, post-conditioning probes were conducted. The study continued follow this sequence, increasing the training/test trial by 5 sec until the target stimuli, worksheets, functioned as a reinforcer for the student to perform responses to the worksheets. Table 4 shows the sequence of the design for Experiment 2.

Table 4: Design Sequence

Phase	Description
1. Pre-pairing probe- one session	15 one min intervals (15 min) * Whole interval recording for independently working on worksheets * Data were also collected, using permanent product, on the number of correct responses on worksheets and number of worksheets completed. * Consequences were not delivered
2. Implementation of stimulus-stimulus pairing procedure 5 sec intervals	*Pair/test trial * Pairing trial- Reinforcement (praise) is delivered 2 or 3 times during pairing session. * Test trial- Experimenter observed student for 5 sec. A (+) was recorded if student emitted behavior for 5 sec, and a (-) was recorded if student did not. Consequences are not delivered following the test trial * Criteria: 18/20 test trials or better for two consecutive sessions. Once students achieved criteria the next phase was implemented.
3. Post-pairing probe: one session	* Same as baseline

4. Implementation of stimulus-stimulus pairing procedure 10 sec intervals	* Same as pair/test trial described above
5. Post-pairing probe: one session	* Same as baseline
6. Implementation of stimulus-stimulus pairing procedure 15 sec intervals	* Same as pair/test trial described above
7. Post-pairing probe: one session	* Same as baseline

*Interobserver Agreement*

Interobserver agreement was measured for 11% of the conditioning sessions for worksheets, which resulted in 100% agreement. During the pre/post probes, interobserver agreement was also conducted for 20% of the probe sessions that resulted in 100% agreement.

*Interscorer agreement*

During probe sessions for conditioning worksheets, data were recorded for several dependent variables using permanent product. Interscorer agreement was conducted by a second independent scorer for the numbers of correct response to learn units, the completion of the activity schedule, and the total number of completed worksheets. To measure agreement on the completion of the activity schedule, a second independent observer recorded data with the experimenters conducting the probe session. For correct responses to learn units on worksheets, the experimenters first scored the responses on a separate data form. Then, an independent second observer scored the responses on the actual worksheets. Scores were then compared. To determine inter-scorer agreement for total number of worksheets completed, the experimenter counted the number of completed worksheets and recorded the number on a separate data form. A second independent observer then counted the number of completed worksheets and recorded the number on a separate data form. Interscorer agreement was calculated by dividing the number of agreements by the total number of agreements and disagreements and multiplying this number by 100%. Interscorer agreement was calculated for 20% of the sessions for completion of activity schedule, which resulted in 100% agreement. Interscorer agreement was conducted for 66% of the probe sessions for the number of correct response to learn units emitted on worksheets. For this, a mean inter-scorer agreement of 94% was calculated. For completion of worksheets, 100% inter-scorer agreement was recorded.

FIGURE 3, NEXT PAGE

Results

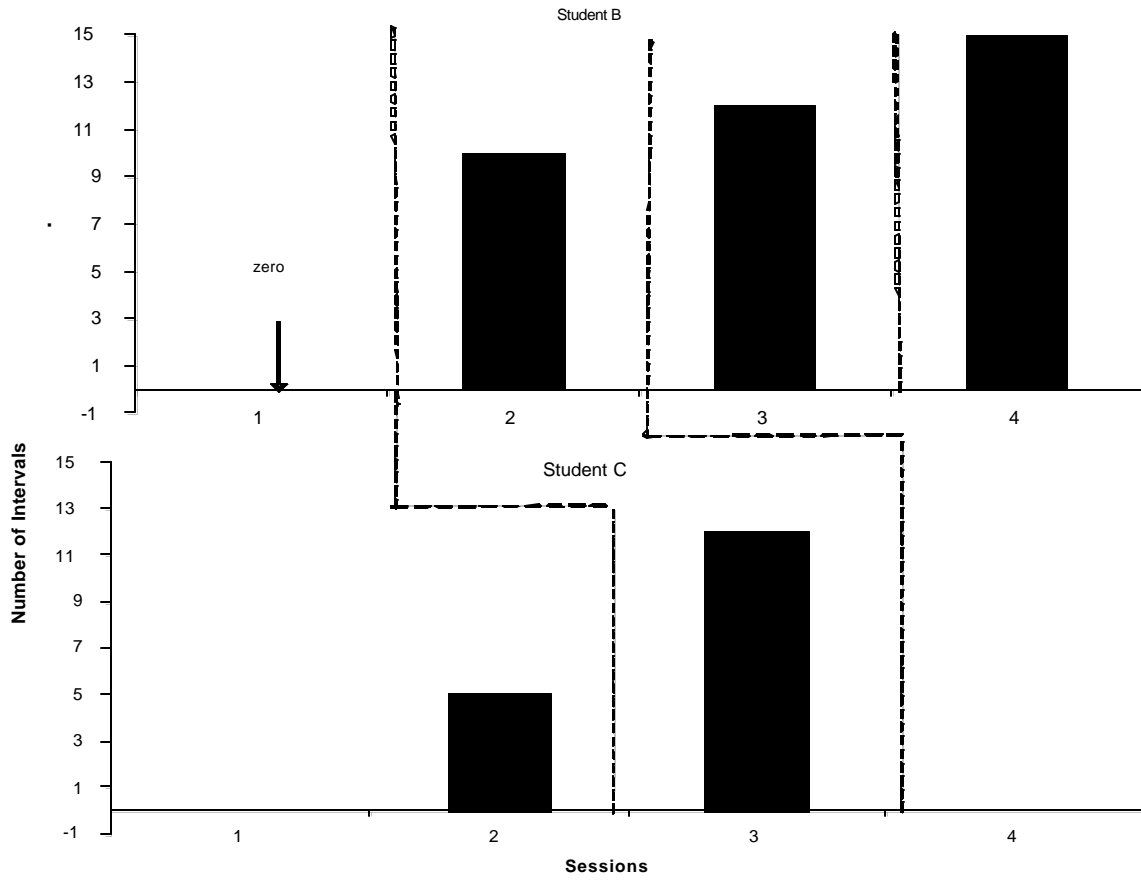


Figure 3. The figure shows the numbers of intervals, out of in which Students B and C appropriately and independently emitted seatwork activities in the form of worksheets during probe sessions.

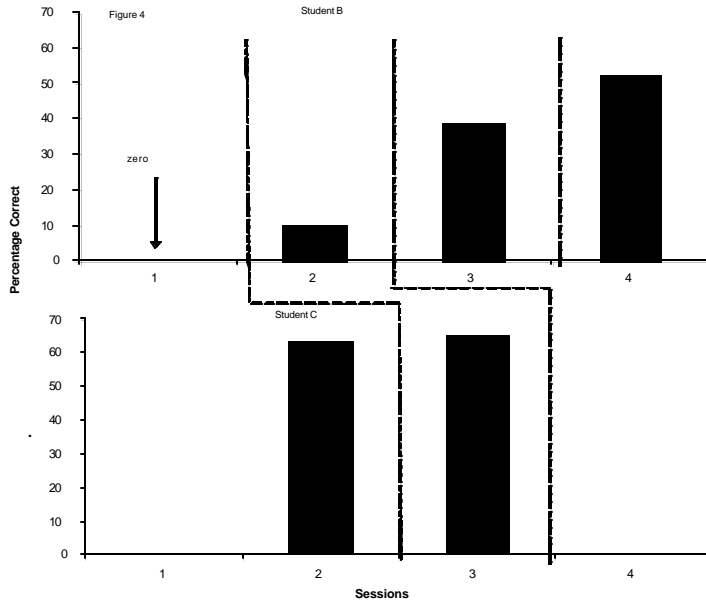


Figure 4. This graph shows the percentage of correct responses on worksheets emitted during each probe session for Students B and C.

Table 5. Total Worksheets Completed

Student	Probe Session	# of Completed Worksheets
Student B	Pre-pairing probe	4
	Post-pairing probe after 5 sec pairing intervals	6
	Post-pairing probe after 10 sec pairing intervals	15
	Post-pairing probe after 15 sec pairing intervals	21
Student C	Pre-pairing probe	6
	Post-pairing probe after 5 sec pairing intervals	7

During the pre-conditioning probe, Student B emitted 0 out of 15 intervals independently working on worksheets, and 0 out of 11 correct responses to learn units on worksheet (0% correct). The student did not complete any worksheets in the pre-baseline probe. A post-training probe was conducted after the student mastered the first phase of the stimulus-stimulus reinforcement

pairing procedure, 5 sec. training/test intervals. During this probe, the student emitted 10 out of 15 intervals of independent work, 4 out of 40 correct responses to learn units (10% correct), and the student completed 6 worksheets. The criterion required the student to independently work on worksheets for the entire 15 min. without emitting any incompatible behaviors. Since the student did not achieve the criterion, a second phase of the stimulus-stimulus pairing procedure, 10 sec. training/test trials, was implemented. After the student met criterion on the second phase, a post-probe was conducted. Student B emitted 12 out of 15 intervals of independent work, 24 correct response out of 62 presented learn units (38.7%), and the student completed 14 worksheets during the second post-conditioning probe. The third phase of the stimulus-stimulus pairing procedure was implemented. After the student met criterion for 15 sec. training/test, a third post-probe was conducted. In this probe, Student B worked independently on worksheets for 15 out of 15 intervals, emitted 67 correct responses to learn units out of 128 learn unit presentation (52.3%), and completed 21 worksheets.

Similarly, results for Student C also showed a significant increase in independent work in the 15 min. probe sessions post-stimulus-stimulus pairing. During pre-probes, Student C emitted 5 out 15 intervals of independent work, 33 correct responses to learn units out of 52 learn unit presentations (63.4%), and completed 6 worksheets. Due to the data collected during the pre-probe, a decision was made to implement the stimulus-stimulus reinforcement pairing procedure. After the student met the set criterion on the first phase, a post-probe was conducted, in which Student C emitted 12 out of the 15 intervals of independent work, 26 correct responses to learn units out of a possible 40 (65%), and completed 7 worksheets.

Figure 5 shows the data collected during the stimulus-stimulus reinforcement pairing procedure for Student B and Figure 6 shows the data collected during the stimulus-stimulus pairing procedure for Student C. In the first phase, Student B met criterion after 5 sessions. Student B met criterion after 3 sessions in the second phase and third phase of conditioning. Student C met criterion after 7 sessions for the first phase, 5 sec. training/test trials.

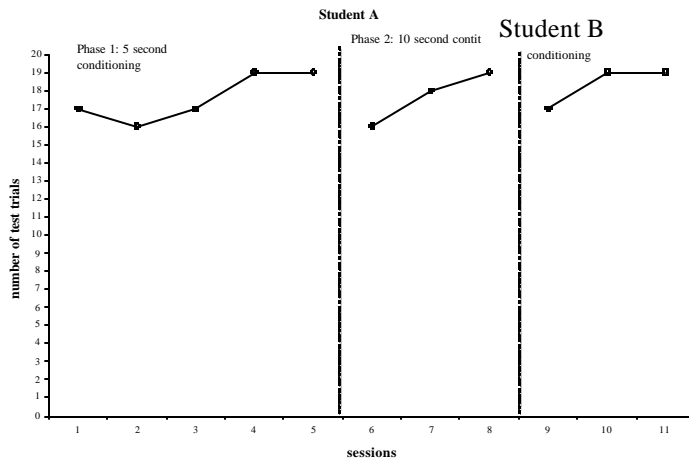


Figure 5. The figure shows the numbers of intervals out of a 20-test interval session in which Student B emitted appropriate behavior during the implementation of the stimulus-stimulus pairing procedure.

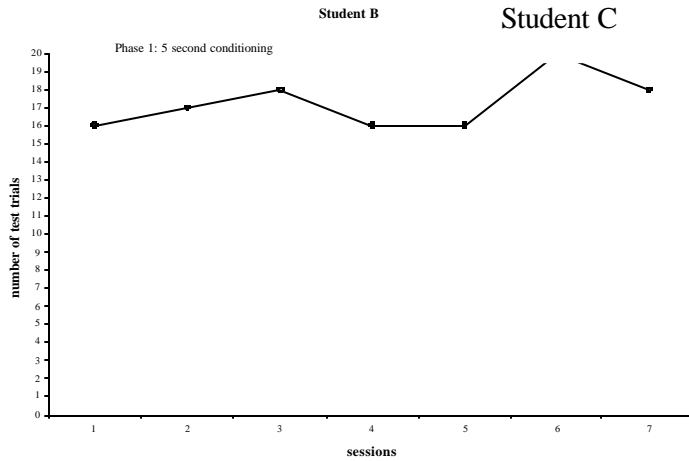


Figure 6. The figure shows the numbers of intervals out of a 20-test interval session in which Student C emitted appropriate behavior during the implementation of the stimulus-stimulus pairing procedure.

### Discussion

Findings from Experiment 2 showed an increase in the number of intervals in which the student worked independently on worksheets, correct responses to seatwork activities, and an increase in the numbers of worksheets completed during probe session as a result of the stimulus-stimulus pairing procedure. Similarly, Tsai and Greer (in press.) found an increase in accuracy of textual responses to textual stimuli after the stimuli acquired reinforcing properties. Results from Experiment II and Tsai and Greer suggested that the stimulus-stimulus pairing procedure was not only effective to decrease stereotypy, but was also effective to increase and accelerate learning.

### General Discussion

Findings from this study suggested that the stimulus-stimulus pairing procedure was effective in increasing appropriate behaviors while decreasing stereotypy. Moreover, the findings from Experiment 2 showed the stimulus-stimulus pairing procedure to be effective to increase student learning and production. In Experiment 1, an increase was observed across appropriate behaviors following the completion of the pairing procedure, which also resulted in a decrease in stereotypy. Many students with autism emit stereotypical behaviors that may interfere with learning. Through the pairing procedure stimuli can be conditioned, teaching students to prefer previously neutral stimuli. As a result, students will select to emit useful behaviors to newly conditioned stimuli rather than stereotypy. Findings from Experiment 1 were consistent with previous research (Greer, Dorow, & Hanser, 1973; Greer, Becker, Saxe, & Mirabella, 1985; Nuzzolo-Gomez, Leonard, Ortiz, Rivera, & Greer, 2002), in which a decrease in stereotypy was observed following the stimulus-stimulus pairing procedure. Furthermore, after the completion of the pairing procedure, students were more likely to emit more appropriate behaviors related to the stimuli that were conditioned.

Experiment 2 showed an increase in the numbers of intervals in which the students emitted independent seatwork and an increase in the production of correct responses to worksheets following the completion of the pairing procedure. Results from this study, along with the findings from Tsai and Greer were significant in that learning was accelerated as a result of the stimulus-stimulus pairing procedure. In the Tsai and Greer study, results showed



accelerated learning of textual responses. In the present study, an increase in correct responses to worksheets resulted from the stimuli acquiring reinforcing qualities. Future studies should further explore the educational significance of this procedure and its effects across academic behaviors and learning.

Dinsmoor (1985) found that greater observing and attending to specific stimuli resulted in an increase in stimulus control for those stimuli. Results from both experiments presented herein show an increase in stimulus control following the pairing procedure. In Experiment 1, stimulus control was transferred to previously neutral stimuli, which resulted in students preferring to play with those stimuli. In Experiment 2, after stimulus control was transferred through observation, students not only selected to manipulate those stimuli, by increasing the numbers of intervals in which students emitted independent work, but they also increased their numbers of correct responses.

One limitation in Experiment 1 was baseline data on appropriate computer play were not at a stable state when the intervention was implemented. A decrease was observed for appropriate computer play during baseline with the exception of the final session of baseline. During this session, the student was laughing at the characters on the computer screen, and in previous sessions the student emitted stereotypy in the form of hand flapping. Laughing was recorded as an inappropriate behavior because it did not fit the behavioral descriptions for stereotypy or passivity. The decision was made to intervene because the student was not manipulating the mouse or actively playing with the computer suggesting that the computer monitor screen was providing a source for stereotypy. After the pairing procedure, the student actively participated with the computer games and stories. However, data were not recorded on the actual participation responses. Future studies, which seek to investigate the effects of the pairing procedure on computer play, should also collect data on the behaviors related to playing and participating with computer software. Also, a decrease in appropriate play was observed in the second post-pairing probe session for looking at books. An increase in passivity was also observed, and instances of stereotypy remained at lower levels. Data suggested that the student did not prefer books at desired levels at the time of the probe. However, as a result of the pairing procedure, the student did not emit stereotypy.

One of the limitations of Experiment 2 was that only two students participated in the study. In future studies using multiple probe designs, at least three participants should be used. Another limitation of Experiment 2 was the limited post-stimulus-stimulus pairing probes conducted with Participant C. Due to the conclusion of the school year, implementation of the procedure was stopped. However, despite the limited sessions, increases were observed across all dependent variables and the findings are promising.

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